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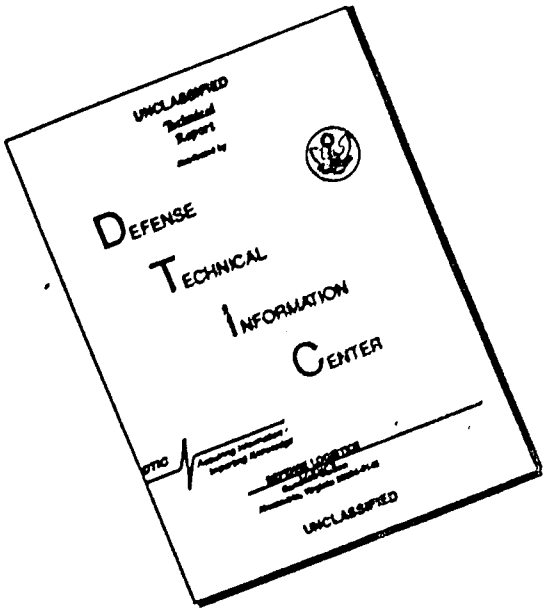
SCIENTIFIC RESEARCH

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VOLUME IV

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AIR FORCE SCIENTIFIC RESEARCH BIBLIOGRAPHY 1960

by

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FOREWORD

A major role of the Air Force Office of Scientific Research is to ensure timely impact of new scientific research activities throughout the world upon the operational Air Force. This role reflects the Air Force's dependency upon a science-based technology for the accomplishment of its increasingly complex missions.

AFOSR helps provide an effective liaison between world science and the Air Force through support of phenomena-oriented research in those sciences of most interest to those seeking to meet the technical requirements of current and future operational units.

AFOSR is able to do this because of its established position within the scientific community as a sponsor of high quality research, with the capability to select from unsolicited proposals that research which offers the greatest promise of contributing to the advancement of Air Force interests in science and technology. Each AFOSR project scientist shares staff responsibility for identifying Air Force problem areas and translating them into scientific research opportunities or in translating scientific knowledge and understanding into results for Air Force users.

Communication with the Air Force user community takes many forms. There is personal contact between AFOSR project scientists or principal investigators and their opposite numbers in Air Force laboratories. Such contacts are highly packed forms of communication depending upon shared backgrounds of common knowledge. Other communication might well be termed "To whom it may concern". This is the formal scientific and technical literature, constituting a permanent record. This must enter into some form of storage and, equally important, must be stored in such a manner as to be found again.

Storage, per se, is not an AFOSR concern. The traditional bibliographic methods of journals and libraries cope, after a fashion, with the published literature; report wholesalers, such as the Defense Documentation Center and the Clearinghouse for Federal Scientific and Technical Information, cope equally well with the unpublished report literature. The product of AFOSR sponsored research is, however, but a small fraction of the input to these mighty establishments.

We of AFOSR have a certain parochial pride in the results of the research we sponsor, both because of its quality and because of its relevance to Air Force needs. We can not, therefore, rest content with established machinery; we want the results of the research we sponsor to be accessible in one convenient form at the desk of the individual scientist and manager.

This volume reports the results of all research supported by the Air Force Office of Scientific Research during calendar year 1960. We have found the predecessors to this volume useful in many ways and we are confident that the current volume will prove equally useful in coupling the results of the research we have supported to both the scientific and the military communities we serve.



William J. Price
Executive Director
Air Force Office of Scientific Research

PREFACE

Prolegomenon

Science, as the self-frocked clerisy of this afterburner era, has managed to achieve the paradoxical position of being both democratic and aristocratic. Democratic in the sense that any one with brains can play the game, regardless of race, creed or national origin; aristocratic (or perhaps in these dank days of inner space, thalassocratic) in that scientists tend to sort themselves into invisible colleges and strive vigorously for rank, both within and among these dark centuries.

This tendency to coalesce into ranked attributes, perhaps more easily explicable by the third book of Genesis than by the Second Law of Thermodynamics, has had one unfortunate result—it has completely confused, confounded and obfuscated the archival role of the scientific literature.

If one admits that the immediate communication of important scientific results takes place via the oral underground—the informal channels of correspondence and telephone calls and corridor gossip at meetings—one is left with serious doubts as to just what it is that the scientific literature is supposed to do. Is it a method of substituting the collective value judgments of the editor and referees for the individual value judgment of the reader? Is it a device for keeping scientists honest, as the editor of one major journal has claimed? Has scientific communication by way of the published paper always been a means of settling priority conflicts by claimstaking rather than avoiding such conflicts by giving information? And if this is so of the refereed journal literature, what of unrefereed technical reports? Should these, like preprints, be regarded only as an obnoxious though historically interesting back-door means of getting publication for a mass of writing that might better be lost?

There is another, more egalitarian, view which holds that if a scientist has completed a piece of research and set forth the results in writing, more especially if the research has been supported by Federal funds, these results should be recorded in a permanent, accessible, form. This attitude might even be called "scholarship"—the first step of which is surely the careful and painstaking accumulation of facts.

And whatever else this book may be—an imposing blue volume to decorate one's shelves, an attempt to document all publications, formal and informal resulting from research sponsored by the Air Force Office of Scientific Research during a given period—it is first and foremost a work of scholarship. And, as a work of scholarship, it is a democratic work, setting forth with equal weight the trivial and the profound, the competent piece of journeyman craftsmanship and the occasional masterpiece. We have made no value judgments in this compilation. Our job has been to assemble all relevant items and render them accessible, both through the act of compilation and through the indexes. The rest is up to the reader.

Scope

This is the fourth volume of a continuing bibliographic series, and includes, within the limitations of the law of diminishing returns, abstracts of all technical reports, journal articles, books, symposium proceedings, and monographs produced and published by scientists supported in whole or in part by the Air Force Office of Scientific Research during the calendar year 1960. Previous publications in this series have been:

Vol. I (1950-1956), issued in 1961
Vol. II (1957-1958), issued in 1964
Vol. III (1959), issued in 1965

The Air Force Office of Scientific Research supports fundamental research in the five major scientific disciplines: physics, chemistry, engineering sciences (subsuming mechanics and propulsion), life sciences (both biological and behavioral, but not medical), and mathematics (including during the period of this bibliography, the information sciences). Thus the publications abstracted herein are multi-disciplinary, their common link being task support by AFOSR.

Sources Searched

References, reports, and clues to the existence of reports were found by searching the indexes and report collection of the Air Force Office of Scientific Research Technical Library, and

the collection of the Defense Documentation Center. Detailed searches were made of each contract file in the several AFOSR Directorates. In addition cover-to-cover searches were made of over 300 scientific journals issued mostly in the time period 1960-1963.

Form of Entry and Arrangement

Inherent in the organization of this book is the concept of the reports within a contract as an unanalyzed monographic series. Reports are posted chronologically and/or alphabetically under contracts, these in turn under departments or laboratories, and these under contractors. This does, in fact, provide a rough subject grouping, with the detailed subject index leading into clusters of like reports.

The abstracts are identified by item numbers and are listed under the numbers in the indexes. The three letter mnemonic code, used in Volumes I and II, has been discontinued, starting with Volume III. The form of entry is, in general, that being used for DDC catalog cards, i.e., source of the document; title; personal author, if any; date; pagination; report number; contract number; and accession number. The chief exception is that the primary entry is by the parent organization followed by the name of the specific laboratory or important subdivision.

Availability of Reports

The principal accession or control numbers, which indicate the locations of reports in collections are:

AD — ASTIA Document or Accessioned Document: available at DDC (Defense Documentation Center), Cameron Station, Alexandria, Virginia 22314

PB — Publication Board: for sale by the Clearinghouse for Federal Scientific and Technical Information (CFSTI), Sills Building, 5285 Port Royal Road, Springfield, Virginia 22151

The fact that a report is abstracted in this book means that a copy of this report existed at the time the abstract was written; it should not be construed to imply that either AFOSR or the Library of Congress necessarily has a copy available for distribution. Those seeking reports should do so from the cited agencies, not from AFOSR.

Indices

A detailed subject index, arranged alphabetically, and a special subject classification for mathematics, have been provided. In addition, there are a contract index, an AFOSR control number index, and a personal author index.

Acknowledgments

Many people have shared in the production of this volume. The work has been fostered and nurtured by the previous Commanders and Executive Director of Air Force Office of Scientific Research: Brigadier Generals H. F. Gregory and B. G. Holzman; Colonels A. P. Gagge and Jack L. Deets; Dr. Knox Millsaps and the present Executive Director, Dr. William Price. During the period of compilation of this volume (not the period of the literature covered) much of the responsibility for documentation within AFOSR was transferred to the Office of the Assistant Executive Director for Research Operations, Major Carl S. Jennings, Jr. He, his administrative assistant for documentation, Miss Arlene D. Blose, and their intermittently faithful computer have been in large part responsible for providing the AFOSR input to this volume.

The bibliographic team has worked under the guidance and leadership of Dr. Clement R. Brown, Head of the Special Bibliographies Section, Science and Technology Division, Library of Congress. The chief bibliographers have been G. Vernon Hooker, Doris C. Yates, Harvey D. Brookins,

Joan E. Halpin, and Parthenia A. Patrick. A special note of gratitude is due to those who have aided in abstracting, subject indexing and typing, especially Thomas C. Goodwin, Bruce Blankenhorn, Joyce A. Wolfe, and Lillie M. Frye. Recognition is also due for the invaluable work in preparation of this manuscript, searching, and preliminary cataloging done by Mrs. Marion S. Carr and Mrs. Phyllis M. Martin.



Harold Wooster
Director of Information Sciences
Air Force Office of Scientific Research

TABLE OF CONTENTS

Foreword iii

Preface v

Abstracts

Aarhus U. (Denmark) 1

Aberdeen U. (Scotland) 1

AeroChem Research Labs., Inc., Princeton, N. J. 1

Aerojet-General Corp., Azusa, Calif. 3

Aeronautical Research Associates of Princeton, Inc., N. J. 8

Aeronautical Research Inst. of Sweden, Stockholm 9

Aeronutronic, Newport Beach, Calif. 10

Air Force Office of Scientific Research, Washington, D. C. 10

Alabama U., University 11

Alfred U., New York 12

Allied Research Associates, Inc., Boston, Mass. 14

American Inst. for Research, Pittsburgh, Pa. 14

Arkansas U., Fayetteville 15

Athens U. (Greece) 17

Atlantic Research Corp., Alexandria, Va. 17

Avco Corp., Everett, Mass. 18

Battelle Memorial Inst., Columbus, Ohio 22

Baylor U., Houston, Tex. 24

Bell Aerospace Corp., Buffalo, N. Y. 27

Bell Aircraft Corp., Buffalo, N. Y. 28

Bern U., Waldau-Bern (Switzerland) 28

Birmingham U. (Gt. Brit.) 33

Bolt, Beranek and Newman, Inc., Cambridge, Mass. 34

Boston U., Mass. 35

Brandeis U., Waltham, Mass. 36

Brazil U., Rio de Janeiro 38

British Columbia U., Vancouver (Canada) 39

Brown U., Providence, R. I. 40

Bryn Mawr Coll., Pa. 48

Burden Neurological Inst., Bristol (Gt. Brit.) 48

Bureau of Mines, Bartlesville, Okla. 49
Bureau of Mines, Pittsburgh, Pa. 50
California Inst. of Tech., Pasadena. 51
California U., Berkeley 59
California U., Los Angeles 84
California U., Santa Barbara 92
Cambridge Language Research Unit (Gt. Brit.) 92
Cambridge U. (Gt. Brit.) 93
Carnegie Inst. of Tech., Pittsburgh, Pa. 97
Case Inst. of Tech., Cleveland, Ohio 99
Catholic U. of America, Washington, D. C. 100
Central State Coll., Wilberforce, Ohio 104
Chicago U., Ill. 104
Cincinnati U., Ohio 117
Colorado U., Boulder 117
Columbia U., New York 119
Combustion Inst., Pittsburgh, Pa. 130
Compagnie de Recherches et d'Etudes Aeronautiques, Paris (France) 131
Connecticut U., Storrs 131
Copenhagen U. (Denmark) 132
Cork U. Coll. (Ireland) 133
Cornell Aeronautical Lab., Inc., Buffalo, N. Y. 134
Cornell U., Ithaca, N. Y. 137
De Paul U., Chicago, Ill. 149
Detroit U., Mich. 149
Directorate of Research Analysis, Alamagordo, N. Mex. 150
Documentation, Inc., Washington, D. C. 150
Drexel Inst. of Tech., Centerton, N. J. 150
Dublin Inst. for Advanced Studies (Ireland) 152
Duke U., Durham, N. C. 152
Eastern Research Group, Brooklyn, N. Y. 160
Edinburgh U. (Gt. Brit.) 160
Electrochemical Soc., New York 160
Fairchild Engine and Airplane Corp., Deer Park, N. Y. 161

Federation of American Societies for Experimental Biology, Washington, D. C. 161
Florida State U., Tallahassee 161
Florida U., Gainesville 167
Fordham U., New York 167
Franklin Inst., Swarthmore, Pa. 168
Franklin Inst., Philadelphia, Pa. 169
Free U. of Brussels (Belgium). 171
Free U. of West Berlin (Germany) 173
Fribourg U. (Switzerland). 173
General Dynamics Corp., Pomona, Calif. 175
General Dynamics Corp., San Diego, Calif. 175
General Electric Co., Cincinnati, Ohio. 176
General Electric Co., Schenectady, N. Y. 176
General Electric Co., Philadelphia, Pa. 177
General Mills, Inc., Minneapolis, Minn. 178
Genoa U. (Italy) 178
George Washington U., Washington, D. C. 179
Georgetown U., Washington, D. C. 179
Georgia Inst. of Tech., Atlanta 180
Georgia U., Athens. 182
Harvard U., Cambridge, Mass. 183
Harvard U., Boston, Mass. 195
Hebrew U., Jerusalem (Israel) 196
Heidelberg U. (Germany) 201
Henri-Rousselle Hospital, Paris (France) 201
Hull U. (Gt. Brit.) 201
Human Sciences Research Inc., Arlington, Va. 203
Illinois Inst. of Tech., Chicago 205
Illinois U., Urbana 210
Indiana U., Bloomington 227
Institute for Advanced Study, Princeton, N. J. 229
Instituto de Investigación de Ciencias Biológicas, Montevideo (Uruguay) 232
Instituto de Neurologia, Montevideo (Uruguay) 233
Instituto de Quimica Fisica, Madrid (Spain) 234

Instituto Nacional de Tecnica Aeronautica Esteban Terradas, Madrid Spain 234
Iowa State U. of Science and Tech., Ames. 236
Israel Inst. of Applied Social Research, Jerusalem. 238
Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy) 239
Istituto Nazionale di Ottica, Florence (Italy) 242
Istituto Superiore di Sanita, Rome (Italy) 247
Itek Corp., Boston, Mass.. 248
Johns Hopkins U., Baltimore, Md. 250
Kansas U., Lawrence 260
Karolinska Inst., Stockholm (Sweden) 260
Keele U., Staffordshire (Gt. Brit.) 263
Kent State U., Ohio 263
Kentucky U., Lexington 264
Kissner, H. G., Goettingen (Germany) 266
Laval U., Quebec (Canada). 267
Lehigh U., Bethlehem, Pa. 267
Leyden U. (Netherlands). 267
Liège U. (Belgium) 267
Litton Industries, Beverly Hills, Calif. 268
Lockheed Aircraft Corp., Sunnyvale, Calif. 268
London U. Coll. (Gt. Brit.) 269
London U. (Gt. Brit.) 270
Long Island Biological Assoc., Inc., N. Y. 271
Louvain U. (Belgium) 271
Lund U. (Sweden) 272
McMaster U., Ont. (Canada) 279
Madrid U. (Spain) 280
Manitoba U., Winnepeg (Canada) 281
Marey Inst., Paris (France) 282
Marseille U. (France). 287
Maryland U., College Park 288
Massachusetts General Hospital, Boston 313
Massachusetts Inst. of Tech., Cambridge 316
Massachusetts Mental Health Center, Boston 385

Massachusetts U., Amherst 385
Materials Research Corp., Yonkers, N. Y. 385
Maudsley Hospital, London (Gt. Brit.) 386
Max-Planck Inst. für Psychiatrie, Munich (Germany) 387
Max-Planck Inst. für Strömungsforschung, Göttingen (Germany) 387
Méditerranéen de Recherches Thermodynamiques, Nice (France) 387
Mellon Inst., Pittsburgh, Pa. 388
Miami U., Coral Gables, Fla. 390
Miami U., Oxford, Ohio 391
Michigan State U., East Lansing 392
Michigan U., Ann Arbor 394
Midwest Research Inst., Kansas City, Mo. 406
Milan U. (Italy) 406
Minneapolis-Honeywell Regulator Co., Hopkins, Minn. 409
Minnesota U., Minneapolis 411
Missouri U., Columbia 425
Mount Zion Hospital, San Francisco, Calif. 425
Naples U. (Italy) 428
National Bureau of Standards, Washington, D. C. 430
National Research Council, Washington, D. C. 43
Nebraska U., Lincoln 434
New Hampshire U., Durham 434
New Mexico U., Albuquerque 435
New York U., N. Y. 437
Nobel Inst. for Physics, Stockholm (Sweden) 448
North American Aviation, Inc., Downey, Calif. 448
North American Aviation, Inc., Canoga Park, Calif. 449
North American Philips Co., Inc., Irvington-on-Hudson, N. Y. 450
North Carolina U., Chapel Hill 451
Northeastern U., Boston, Mass. 459
Northwestern U., Evanston, Ill. 459
Norway Technical U., Trondheim 465
Ohio State U. Research Foundation, Columbus 466
Oklahoma State U., Stillwater 472

Oklahoma U., Norman 473
Oregon U., Eugene 474
Oslo U. (Norway) 474
Oxford U. (Gt. Brit.) 480
Paris U. (France) 487
Pavia U. (Italy) 488
Pennsylvania State U., University Park 489
Pennsylvania U., Philadelphia 502
Pisa U. (Italy) 509
Pittsburgh U., Pa. 513
Plasmadyne Corp., Santa Ana, Calif. 515
Politecnico di Milano (Italy) 516
Politecnico di Torino (Italy) 516
Polytechnic Inst. of Brooklyn, N. Y. 517
Pontifical Catholic U. of Rio de Janeiro (Brazil) 528
Princeton U., N. J. 529
Puerto Rico U., Mayaguez 546
Purdue Research Foundation, Lafayette, Ind. 546
Purdue U., Lafayette, Ind. 548
Radio Corp. of America, Princeton, N. J. 555
Rensselaer Polytechnic Inst., Troy, N. Y. 557
Republic Aviation Corp., Farmingdale, N. Y. 564
RIAS, Inc., Baltimore, Md. 566
Rice U., Houston, Tex. 574
Rochester U., N. Y. 574
Rome U. (Italy) 579
Royal Coll. of Science and Tech., Glasgow (Scotland) 580
Royal Inst. of Tech., Stockholm (Sweden) 581
Rutgers U., New Brunswick, N. J. 584
St. John's U., Jamaica, N. Y. 588
St. Louis U., Mo. 589
San Andres U., La Paz (Bolivia) 589
Siena U. (Italy) 591
Societe Francaise d'Etudes et de Realisations d'Inventions Coanda, Clichy (France) 592

South Carolina U., Columbia 592
Southern California U., Los Angeles 593
Stanford Research Inst., Menlo Park, Calif. 599
Stanford U., Calif. 602
Stevens Inst. of Tech., Hoboken, N. J. 638
Stockholm U. (Sweden) 640
Sundstrand Machine Tool Co., Rockford, Ill. 641
Sydney U. (Australia) 641
Syracuse U., N. Y. 642
Technical Research Group, Inc., Syosset, N. Y. 650
Technion - Israel Inst. of Tech., Haifa 650
Technische Hochschule, Karisruhe (Germany) 655
Technische Hochschule, Munich (Germany) 655
Technische Hochschule, Vienna (Austria) 657
Temple U., Philadelphia, Pa. 657
Texaco Experiment, Inc., Richmond, Va. 657
Texas A. and M. Coll., College Station 658
Texas Technological Coll., Lubbock 658
Texas U., Austin 658
Thiokol Chemical Corp., Denville, N. J. 661
Thompson Ramo-Wooldridge, Inc., Canoga Park, Calif. 663
Thompson Ramo-Wooldridge, Inc., Los Angeles, Calif. 663
Tiltman Langley, Ltd., Surrey (Gt. Brit.) 663
Toronto U. (Canada) 664
Training Center for Experimental Aerodynamics, Brussels (Belgium) 666
Trieste U. (Italy) 667
Tufts U., Medford, Mass. 667
Turin U. (Italy) 668
Uppsala U. (Sweden) 669
Utah U., Salt Lake City 677
Veterans Administration Hospital, Boston, Mass. 681
Vienna U. (Austria) 681
Virginia U., Charlottesville 682
Vitro Corp. of America, West Orange, N. J. 684

Washington State U., Pullman 685
Washington U., St. Louis, Mo. 686
Washington U., Seattle 694
Wayne State U., Detroit, Mich. 698
Weizmann Inst. of Science, Rehovoth (Israel) 703
Western Ontario U., London (Canada) 705
Western Reserve U., Cleveland, Ohio 709
Westinghouse Electric Corp., Pittsburgh, Pa. 712
Wisconsin U., Madison 713
Wright Air Development Directorate, Ohio 717
Yale U., New Haven, Conn. 718
Yeshiva U., New York 727
Zator Co., Cambridge, Mass. 731

Contract Index 733
OSR Control Number Index 763
Author Index 783
Subject Index 825
Mathematical Subject Classification 903



1

[Aarhus U. Mathematical Inst. (Denmark)].

ON CERTAIN CONVERGENCE PROPERTIES FOR SEQUENCES OF INDICATORS, by O. Barndorff-Nielsen. Dec. 19, 1959 [13]p. (Technical scientific note no. 2) (AFOSR-TN-60-235) (AF 61(052)42) AD 240328 Unclassified

The connection between convergence properties for sequences of indicators $\{I_n\}$ and certain of their subsequences is investigated. An indicator is a random variable assuming only the values 0 and 1. The main result is the following theorem: Let $\{I_n\}$ be a sequence of indicators and let $\{I_{k_n}\}$ be a subsequence for which $[(k_{n+1} - k_n)/k_n] \to 0$ for $n \to \infty$ and $P\{I_{k_n+1} = I_{k_n+2} = \ldots = I_{k_{n+1}}\} \to 1$ for $n \to \infty$. Let $N_n = \Sigma I_\nu$ and let $N'_n = \Sigma(k_\nu - k_{\nu-1}) I_{k_\nu}$, $\nu = 1, \ldots, n$, $(k_0 = 0)$. Then, for $n \to \infty$, N_n/n converges weakly to a random variable N if and only if N'/k_n converges weakly to N. A corollary of the theorem is applied to the question of the validity of the arc sine law for the number of positive sums of random variables.

2

Aarhus U. [Mathematical Inst.] (Denmark).

INVESTIGATIONS OF THE VALIDITY OF THE ARC-SINE LAW, by E. S. Andersen. Technical summary rept. no. 2. Feb. 29, 1960 [6]p. (AFOSR-TN-60-674) (AF 61(052)42) AD 241396 Unclassified

For a sequence of r.v.'s $X_1, X_2, \ldots$ the r.v. N_n is defined as the number of positive sums among $S_1, \ldots, S_n$, where $S_k = X_1 + \ldots + X_k$. Under rather general assumptions on $X_1, X_2, \ldots$ the limit distribution of N_n/n is known to be the arc-sine law: $F(x) = \frac{2}{\pi} \arcsin x^{1/2}$ $0 \le x \le 1$. New sufficient conditions for the validity of the arc-sine law for N_n have been obtained. Furthermore the limit distribution of N_n/n has been found in some special cases, where the arc-sine law does not hold. (Contractor's abstract)

3

Aarhus U. [Mathematical Inst.] (Denmark).

THE DETERMINANTS OF THE TOEPLITZ MATRICES OF AN ARBITRARY LAURENT POLYNOMIAL, by P. Schmidt. Aug. 20, 1960, 21p. (Technical scientific note no. 4) (AFOSR-TN-60-1383) (AF 61(052)42) AD 246963 Unclassified

Also published in Math. Scand., v. 8: 15-38, 1960.

Determinants $|T(n,p)|$, $n = 1,2,\ldots$, $p = 0, \pm 1, \pm 2, \ldots$, of Toeplitz matrices of the type $T(n,p) = \{a_{p+1-j}\}$, $i, j = 1,2,\ldots,n$, $a_0 = 1$, $a_\nu = 0$ for $\nu < 0$, is studied. A relation is found reducing the case $p > 1$ to the case $p = 1$. By means of this the determinants of the Toeplitz matrices of a given Laurent polynomial $f(z)$ is expressed explicitly in terms of the zeros of $f(z)$. This is applied to determine the asymptotic behavior of such determinants. (Contractor's abstract)

4

Aberdeen U. [Dept. of Chemistry] (Scotland).

STRUCTURAL CHEMISTRY OF SILICATES AND RELATED SUBSTANCES, by H. F. W. Taylor, L. S. Glasser, and F. P. Glasser. Sept. 1, 1960, 18p. incl. illus. refs. (Technical scientific note no. 1) (AFOSR-172) (AF 61(052)276) AD 264712 Unclassified

Studies of oriented transformations, and crystal chemistry of oxides are described. Detailed study of the oriented transformations rhodonite to wollastonite provides direct evidence of the migration of Si during thermal transformations of silicates. The results of dry heating and hydrothermal treatment of a variety of other silicates are described. Crystal chemical studies, including a number of RO-R203 compounds are in progress. The stability relationships of the calcium gallates are described. (Contractor's abstract)

5

AeroChem Research Labs., Inc., Princeton, N. J.

THE THEORY OF RADIATION COOLING AT HIGH MACH NUMBERS, by D. E. Rosner. Nov. 18, 1959, 15p. incl. diagrs. tables, refs. (Rept. no. TM-18) (AFOSR-TN-60-331) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)300 and Wright Air Development Center under AF 33(616)6213) Unclassified

A steady state in a chemically inert high speed stream in which the convective heat transfer to a solid body is balanced entirely by radiation from it is considered. The situation is analogous to an isothermal catalysis problem and results are presented for local and overall rates of radiation energy transfer from flat plates in high speed streams. It is shown that if 2 plates differing only in their thermal conductivities are placed in identical gasdynamic environments, the insulating plate loses more energy by radiation than a perfectly conducting plate, thereby extracting more energy from the fluid. By generalizing the conventional notion of laminar "recovery temperature" the results are shown

to apply also to active catalysts in dissociated streams, provided the amount of atom recombination within the diffusion boundary layer can be neglected.

6

AeroChem Research Labs., Inc., Princeton, N. J.

REACTION RATE DISTRIBUTIONS ON CATALYTIC SURFACES. II. COMPARISON OF EXACT AND APPROXIMATE FLAT PLATE SOLUTIONS FOR ASYMPTOTICALLY SMALL PRANDTL NUMBER, by D. E. Rosner. Apr. 1960, 13p. incl. tables, refs. (Rept. no. TP-16) (AFOSR-TN-60-690) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)300 and Wright Air Development Center under AF 33(616)6216) AD 237929; PB 148230 Unclassified

The chemical reaction rate distribution along a catalytic plate immersed in a uniform incompressible fluid stream containing a reactant in dilute amounts is shown to satisfy a familiar integral equation when the Prandtl number for diffusion ($Pr_D = \nu/D$) [also called Schmidt number] asymptotically approaches zero. A closed form, exact solution exists for the case of first order chemical surface reaction. This solution is, at the same time, rigorously equivalent to the transient surface temperature decay of a "radiating" semi-infinite solid slab and approximately equivalent to the decay of slip velocity along a flat plate in constant density slip flow. While frequently overlooked, each classical transient heat conduction solution subject to the appropriate "radiation" boundary condition for a prescribed geometry can therefore be utilized to predict the behavior of a cylindrical "slug flow" catalytic reactor of the same cross-section. The closed form, exact solution to the catalytic plate problem provides a convenient standard against which two approximate methods, intended to span the entire range of Prandtl numbers, are compared. It is concluded from this comparison that global diffusion corrections $\bar{\eta}$ (= actual over-all conversion/chemically controlled conversion) computed assuming a constant (fictitious) reactant concentration along the catalytic surface probably represent exact solutions to the laminar diffusion layer equations (with first order chemical reaction) to within 4.8% over the entire range of Prandtl number $Pr_D = \nu/D$. In contrast, calculations made using the well-known Frank Kamenetzkii, "quasi-stationary method" can be in error by as much as 14.6%. (Contractor's abstract)

7

AeroChem Research Labs., Inc., Princeton, N. J.

DIFFUSION AND CHEMICAL SURFACE CATALYSIS IN FLOW SYSTEMS, by D. E. Rosner. July 1960, 53p. incl. diagrs. tables, refs. (Rept. no. TP-14) (AFOSR-TN-60-887) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)300 and [Wright Air Development Center] under AF 33(616)6216) AD 250994 Unclassified

Presented at the Amer. Chem. Soc. I/EC Symposium on Mechanisms of Interfacial Reaction, Johns Hopkins U., Baltimore, Md., Dec. 28-29, 1959.

The role of a catalytic parameter governing the transition from activation to diffusion controlled heterogeneous kinetics in flow systems is discussed with respect to the determination of reaction rate distributions along catalytic surfaces of arbitrary shape and chemical activity, energy transfer from dissociated gases to catalytic surfaces, and correction factors in the theory of differential catalytic probes in analytical chemistry. Detailed, closed form solutions are given to the laminar flow catalytic plate problem with arbitrary reaction order. The method corrects for the influence of the history of the surface reaction on the diffusional mass transfer coefficient itself.

8

AeroChem Research Labs., Inc., Princeton, N. J.

CALCULATION OF EQUILIBRIA IN THERMALLY IONIZED GASEOUS MIXTURES — THE SAHA EQUATION, by D. E. Rosner. Sept. 1958, 37p. incl. diagrs. tables, refs. (Rept. no. TM-11) (AFOSR-TN-60-888) (Sponsored jointly by Air Force Ballistic Missiles Division under AF 04(647)157 and Air Force Office of Scientific Research under AF 49(638)300) AD 236199 Unclassified

The method by which equilibrium constants for ionization reactions may be computed from available spectroscopic data is discussed. Several examples are presented to illustrate the methods involved as well as the nature of the permissible assumptions. These examples include ionization equilibrium calculation for atomic oxygen, argon and nitric oxide each at temperatures below 10,000°K.

9

AeroChem Research Labs., Inc., Princeton, N. J.

THE THEORY OF DIFFERENTIAL CATALYTIC PROBES FOR THE DETERMINATION OF ATOM CONCENTRATIONS IN HIGH SPEED, NON-EQUILIBRIUM STREAMS OF PARTIALLY DISSOCIATED GASES, by D. E. Rosner. Oct. 1960, 37p. incl. diagrs. table, refs. (Rept. no. TP-19) (AFOSR-18) (AF 49(638)300) AD 254660; PB 155830 Unclassified

A rational catalytic probe theory, suited to the analysis of supersonic streams of non-equilibrium partially dissociated gas is developed. The design criteria of such a probe is investigated and the gasdynamic circumstances under which such a probe can be used are discussed. It is concluded that catalytic probe techniques offer the most important aerodynamic advantage

of being able to yield local values of the atom concentration. It is pointed out that for low stagnation temperature, highly non-equilibrium supersonic streams, a continuum differential catalytic thermometer (uncooled) can be designed offering the theoretical advantages of (1) output linearly proportional to free stream atom concentration regardless of the true order of the interfacial reaction, (2) output insensitive to small changes in the catalytic activities of the probe surfaces, and (3) output insensitive to the details of the gasdynamic environment (Mach number, Reynolds number) and catalyst shape. For high stagnation temperatures, it will probably be necessary to sacrifice the last of these advantages in favor of internally cooled catalytic probes.

10

AeroChem Research Labs., Inc., Princeton, N. J.

STUDIES OF ATOM CONCENTRATION IN A LOW TEMPERATURE PLASMA JET (Abstract), by D. E. Rosner and H. F. Calcote. 1960 [1]p. (Bound with its AFOSR-TN-60-1063) (AF 49(638)300) Unclassified

Presented at First AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, General Dynamics Corp., General Atomic Div., San Diego, Calif., Sept. 6-7, 1960.

A low temperature plasma jet has been developed to produce a supersonic stream of non-equilibrium concentrations of nitrogen atoms at pressures of a fraction of a mm Hg to 10 mm Hg. While the static temperature in the jet is about 300°K and the stagnation temperature about 1500°K, the degree of dissociation corresponds to an equilibrium temperature of about 6,000°K. A technique and the theory for employing a catalytic probe to determine nitrogen atom concentrations in a supersonic stream are being developed. The experimental results are compared with those obtained by a chemical titration. The addition of various chemical additives to the stream is employed to determine the species in the stream to which the probe responds. Heat transfer to a catalytic porous plug probe is also being measured with gases of different chemical reactivity passing through the plug. These alter the position, in the gas phase or on the catalytic surface, at which atom recombination occurs and thus changes the rate of heat transfer. Difficulties with electrode sputtering have been minimized by reversing the discharge polarity. Future plans call for continuation of the present approach with the addition of a photometric technique.

11

Aerojet-General Corp., Azusa, Calif.

KINETIC STUDIES OF DISAPPEARANCE OF HYDROXYL RADICALS IN ICE AT LOW TEMPERATURES, by J. M. Flournoy, L. H. Baum and others. [1959] [5]p. incl. table. (AFOSR-TN-59-539) (AF 18(603)110) AD 216556 Unclassified

Also published in Fourth Internat'l. Symposium on Free Radical Stabilization, Dunbarton Coll., Washington, D. C. (Aug. 31-Sept. 2, 1959), Washington, D. C., Nat'l. Bureau of Standards, 1959, p. B-IV-1 - B-IV-5.

The system OH in ice was utilized to study the mechanisms of chemical reactions involving highly reactive free radicals trapped in rigid media. The rate law $\frac{d(OH)}{dt} = -k(OH)^2$ was found to describe accurately the disappearance of OH in ice for at least 70% decomposition at temperatures from 92° - 107.5°K. In order to assure a constant sample weight and geometry in the microwave cavity, some samples were used for several kinetic runs by warming (without melting) to destroy residual radicals, and re-irradiating at 77°K. It was found that cumulative dosages above $2 \times 10^{\circ}$ rep caused a gradual increase in the rate constant. The kinetic data are best described by a rate constant, $k = 6 \times 10^{12} \exp(-6000/RT)(m/l)^{-1}\text{sec}^{-1}$ from 77° to 107.5°K. It is postulated that the rate determining process is diffusion or migration of the radicals through the ice.

12

Aerojet-General Corp., Azusa, Calif.

A TEMPERATURE-CONTROL METHOD FOR USE BETWEEN 4.2 AND 77°K, by J. M. Flournoy, L. H. Baum, and S. Siegel. Aug. 1960 [9]p. incl. diagrs. (Rept. no. TN-37) (AFOSR-TN-60-760) (AF 18(603)-110) AD 241842; PB 150164 Unclassified

Also published in Rev. Scient. Instr., v. 31: 1133-1135, Oct. 1960.

A simple system is described for maintaining controlled experimental temperatures between the normal boiling points of helium and nitrogen. No special apparatus is involved other than that normally required for the handling of liquid helium and the measurement of low temperatures. The technique has been used to control the temperature of a resonant cavity to within ± 0.2°K, for T > 20°K using a copper-constantan thermocouple and a variable-range recording potentiometer to measure temperature. (Contractor's abstract)

13

Aerojet-General Corp., Azusa, Calif.

IRRADIATION YIELDS OF RADICALS IN GAMMA IRRADIATED ICE AT 4.2 AND 77°K, by S. Siegel, J. M. Flournoy, and L. H. Baum. Jan. 1961 [24]p. incl. diagrs. table. (Rept. no. TN-39) (AFOSR-TN-60-947) (AF 18-(603)110) AD 250131; PB 154315 Unclassified

Also published in Jour. Chem. Phys., v. 34: 1782-1788, May 1961.

The electron-paramagnetic-resonance (EPR) spectra of both ice and deuterated ice which were subjected to gamma-irradiation at 4.2°K are presented and discussed. Experimental radical irradiation yields at 4.2°K are reported for the H_2O system as a function of sustained irradiation dosage. A comparison between the irradiation yields at 4.2° and 77°K is given, and the resulting similarities are discussed in terms of intra-spur reactions. Finally, preliminary evidence is presented for the existence of an appreciable isotope effect for the irradiation yields in a mixture of H_2O and D_2O. (Contractor's abstract)

14

Aerojet-General Corp., Azusa, Calif.

OBSERVATIONS OF THE THERMAL BEHAVIOR OF RADICALS IN GAMMA-IRRADIATED ICE, by S. Siegel, L. H. Baum and others. [1960] [8]p. incl. diagrs. table, refs. [AF 18(603)110] Unclassified

Published in Jour. Chem. Phys., v. 32: 1249-1256, Apr. 1960.

Ice was subjected to γ radiation at 77°K and the EPR spectra of the radicals produced were examined as a function of temperature. The spectrum consisted essentially of a doublet centered at g = 2.008 ± 0.002 and split by 40 gauss; the corresponding spectrum of irradiated D_2O consisted of a triplet with approximately 6 gauss between adjacent lines. The doublet decayed rapidly above 100°K leaving a residual broad line which was thermally stable until approximately 145°K. The main spectrum has been attributed to the OH radical and the residual line assigned to the HO_2 radical. The decay process of the OH radical was shown to follow the rate $d(OH)/dt = -k(OH)^{3/2}$ where $k = 8.5 \times 10^{12} \exp(-6000/RT)$ $(l/mol)^{1/2}$ sec^{-1}. The magnitude of the rate constant was shown to be a function of the total irradiation damage experienced by the ice sample. Stabilization of OH radicals at 77°K was studied as a function of total irradiation dosage; saturation is reached at an OH concentration of 1.8×10^{-3} M or 0.003 mol %. The EPR spectrum of a frozen aqueous NO solution was also observed; it consisted of a hard line approximately g = 2.08. (Contractor's abstract)

15

Aerojet-General Corp., Azusa, Calif.

KINETICS OF RADICAL FORMATION AND RECOMBINATIONS AT LOW TEMPERATURES (Abstract), by S. Siegel, J. M. Flournoy, and S. Skolnik. [1960] [1]p. (AF 18(603)110) Unclassified

Presented at First AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, General Dynamics Corp., General Atomic Div., San Diego, Calif., Sept. 6-7, May 1961.

The ESR spectra of the radicals formed by γ-irradiation of ice at 77° and 4.2°K will be presented and discussed. The spectrum of irradiated ice at 4.2°K consists primarily of 2 distinct doublets which have been identified as being due to trapped H atoms and OH radicals. The line intensities of the spectra were used as a concentration index to study the irradiation yields of stabilized radicals and atoms under sustained irradiation. The accumulation of trapped radicals as a function of irradiation dosage at both 77° and 4.2°K will be described. These curves will be discussed in terms of intra-spur recombination reactions. This concept of intra-spur reactions will be supported by a discussion of the kinetics of the reactions of trapped H atoms between 4.2° and 77°K. It will be shown that the concentration of trapped H atoms decays according to a reaction mechanism which has a first order dependence upon the reactive H concentration. The study of the decay of the stabilized H atom concentration also revealed that the H atoms are stabilized with a range of stabilization energies, varying from 300 cal/mol to over 1500 cal/mol. The maximum concentration of radicals observed was $\sim 2 \times 10^{-3}$ mol/l for both the H atoms and OH radicals (this was not the saturation concentration). The energy storage, on the basis of recombination reactions, corresponding to a concentration of 2×10^{-3} mol/l of OH and H, is approximately 15% of the absorbed gamma energy.

16

Aerojet-General Corp., Azusa, Calif.

INVESTIGATION OF HIGH-ENERGY OXIDIZER BINDERS FOR SOLID PROPELLANTS (Unclassified title), by R. Fischer and S. Skolnik. [Jan. 1960] [48]p. incl. illus. diagrs. tables. [Rept. no. 1734] [AFOSR-TR-60-22] [AF 49(638)25] AD 315622 Confidential

17

Aerojet-General Corp., Azusa, Calif.

INHERENT STABILITY OF THE COMBUSTION PROCESS, by R. S. Pickford and R. G. Peoples. Nov. 1960, 72p. incl. diagrs. refs. (Rept. no. TN-36) (AFOSR-676) (AF 49(638)178) AD 255032 Unclassified

Presented at Fifteenth meeting of the Amer. Rocket Soc., Washington, D. C., Dec. 5-8, 1960.

A method is presented for determining the inherent stability of a combustion process. The application of this technique enables the designer to increase the inherent stability of any combustion system. This paper

is primarily concerned with the "initiation mechanism" for combustion instability. Techniques for describing the conditions leading to the suppression, or the reinforcement, of destructive pressure waves within a combustion chamber are discussed. It is believed that the combustion model presented is applicable to all modes of high-frequency combustion instabilities in any type of combustion system. Although the major emphasis is placed on liquid-propellant combustors, the techniques are believed to be applicable to gaseous- and solid-propellant systems as well. The causes of marginal stability are outlined and a method introduced which has the capability of determining inherent stability with knowledge only of the stable combustion process and the chamber geometry.

18

Aerojet-General Corp., Azusa, Calif.

ANALYTICAL AND EXPERIMENTAL SCALING OF THRUST CHAMBERS, by R. G. Peoples and R. S. Pickford. Nov. 1960, 26p. incl. diagrs. (Rept. no. TN-40) (AFOSR-677) (AF 49(638,178) Unclassified

Several effective techniques for preventing difficulties associated with high-frequency combustion instability are presented in this study of analytical and experimental techniques for scaling combustion systems with regard to the stability of energy release. It is known that combustion is related to combustion-chamber geometry in equations that permit large thrust devices to be built from models. It is shown that inherent combustion stability depends on relationships between cyclic pressure modes (controlled by chamber geometry) and replenishment of pressure-sensitive energy (a function of chemical and physical processes). Data are presented which relates the chamber geometry and reaction processes to inherent stability.

19

Aerojet-General Corp., Azusa, Calif.

TANGENTIAL INSTABILITY IN ROCKET CHAMBERS (Abstract), by R. S. Pickford. [1960] [1]p. (Bound with its AFOSR-TN-60-37) (AF 49(638)178) Unclassified

Presented at Twelfth AFOSR Contractors' meeting on Liquid Propellant Rocket Combustion, Purdue U., Lafayette, Ind., Mar. 2-3, 1960.

Progress made to date under this AFOSR contract was reviewed in this report to the members of the Liquid Propellant Rocket Combustion meeting. It is pointed out that in the solution of tangential combustion instability three factors must be considered: (1) the initial energy available for support of pressure fronts during stable combustion, (2) the rate of production of available energy after passage of a pressure front, and (3) the time period between passage of the initial front and the next disturbance. It has been found that each of these items are closely related to (1) the energy-release contour and (2) the energy preparation rate. The "energy-release contour" is defined as the distribution of local energy-release rates throughout the combustion chamber. The "energy preparation rate" is defined as the rate of replenishment of the localized volumetric energy which is available for pressure-sensitive combustion.

20

Aerojet-General Corp., Azusa, Calif.

A SEARCH FOR THE IONIZATION OF H_2 ON DIFFUSION THROUGH Pd, by J. R. Radbill and R. J. Sunderland. Feb. 1960 [18]p. incl. diagrs. refs. (Rept. no. TN-34) (AFOSR-TN-60-426) (AF 49(638)214) AD 237256; PB 147505 Unclassified

A search has been made to detect the ionization of hydrogen through palladium. Using as a source a 0.005-in. palladium foil maintained at 1000°K, the mass spectrum of the emission was determined, with and without the diffusion of hydrogen. Ions corresponding to singly charged Na^{23}, K^{39} and K^{41} were detected with the Na^{23} mass peak predominating. No other ions were found within the mass range capability (1-240 amu) of the magnetic fields used. The results indicate that the individual ion current densities at the emitter, due to thermally ionized hydrogen atoms or molecules, must be less than 10^{-0} amp/cm^2.

21

Aerojet-General Corp., Azusa, Calif.

THE DEVELOPMENT OF A MASS SPECTROMETER FOR ION STUDIES, by R. J. Sunderland and J. R. Radbill. June 1960 [21]p. incl. diagrs. table. (Rept. no. TN-35) (AFOSR-TN-60-702) (AF 49(638)214) AD 240229; PB 149561 Unclassified

In order to determine the mass spectrum of the emission from a particular source, a magnetic-sector-field mass spectrometer was constructed. This instrument is a first-order-focusing type, having a 60°-sector magnetic field in which the ion trajectories have a 5-in. radius of curvature. The spectrometer is constructed entirely of metal, with the central portion of the tube forming the pole faces of the magnet, which has high-impedance windings. The magnet-current power supply, regulated to 1 part in 10^4, is capable of generating fields greater than 16,000 gauss in the focusing region. The precision accelerating voltage is also regulated to 1 part in 10^4 up to 15 kv at 10 ma. The system is evacuated by a 6 in. oil-diffusion pump which is well trapped with liquid nitrogen; pressures throughout the system are of the order of 10^{-6} mm Hg. The instrument was designed primarily to investigate the mass spectrum of ions produced thermally on surfaces. Since such sources

usually evolve neutral gases at high rates, the spectrometer is pumped from the source end through a 3 in. ID coupling adjacent to the ion source. Positive-ion masses in the range from 6 to 184 atomic mass units and negative ions with masses of about 150 atomic mass units have been studied with this instrument. The resolving power of the system is approximately 200 for the thermally produced positive ions.

22

Aerojet-General Corp., Azusa, Calif.

SURFACE EMISSION OF POSITIVE IONS (Abstract), by R. J. Sunderland. [1960] [1]p. (Bound with its AFOSR-TN-60-405; AD 235949) (AF 49(638)214) Unclassified

Presented at Third AFOSR Contractors' meeting on Ion and Plasma Propulsion, Farmingdale, N. Y., Mar. 22-24, 1960.

This research is concerned with the mechanism of positive ion production at both metallic and non-metallic surfaces, and methods for the continuous replenishment of surface films. Studies of the ionization of hydrogen on diffusion through palladium at temperatures of approximately 1000°K, and the ionization of sodium upon electrolysis through platinum coated soda-lime glass, have been completed. At present the program is divided into 3 separate investigations. The first involves the ionization of alkali metals upon diffusion through porous tungsten. Measurements are being made of current densities and positive-to-neutral ratios for various configurations of the extracting and focusing electrodes. A second series of experiments is concerned with the diffusion properties of porous tungsten. Inert gases are being used to study the diffusion parameters of porous tungsten specimens of different densities both before and after these specimens have been used as ionizing surfaces. The third system under investigation is one in which alkali metal vapors are ionized in a hollow cavity.

23

Aerojet-General Corp., Azusa, Calif.

VACUUM APPLICATION OF INDUSTRIAL GLASS PIPE, by L. K. Branson and R. J. Sunderland. [1960] [2]p. incl. illus. diagr. table. [AF 49(638)214] Unclassified

Published in Rev. Scient. Instr., v. 31: 665-666, June 1960.

The advantages of using Corning Pyrex brand pipe in the laboratory in vacuum systems is pointed out. It is shown that cleanliness, transparency, smooth internal surface, heat resistance, ease of assembly, high strength, and flexibility are some features of the glass ware not found in the commonly used metal vacuum jackets. The various size fittings and tubing are listed and the availability of the pyrex glass shown. The largest diameter piping available is 6 in.

24

[Aerojet-General Corp., Azusa, Calif.]

NOTE ON EVAPORATION, by S. A. Zwick. [1960] [7]p. incl. diagrs. [AF 49(638)252] Unclassified

Published in Jour. Appl. Phys., v. 31: 1735-1741, Oct. 1960.

A simple kinetic model is employed to investigate non-equilibrium evaporation from a liquid. Molecules are assumed to evaporate into a (one-sided) Maxwellian velocity distribution at the liquid surface. Molecules reaching the surface from the vapor are assumed to form part of an ellipsoidal velocity distribution. Of the molecules approaching the interface only the fraction α condenses there; the remainder is taken to undergo specular reflection back into the vapor. By equating physical conditions at the surface with conditions in the vapor, the vapor pressure can be related to that which would prevail at equilibrium, as a function of the surface accommodation coefficient α and the mean velocity u of the vapor relative to the interface. (Contractor's abstract)

25

Aerojet-General Corp., Azusa, Calif.

KINETICS OF RECOMBINATION OF ATOMIC OXYGEN AT ROOM TEMPERATURE, by H. L. Petersen and C. P. Kretschmer. Nov. 1960 [23]p. incl. diagrs. tables, refs. (Rept. no. TN-38) (AFOSR-TN-60-1478) (AF 49(638)540) AD 283044 Unclassified

Also published in Jour. Chem. Phys., v. 33: 948-949, Sept. 1960. (Title varies)

Oxygen was partly dissociated by a microwave discharge in static experiments, and the absolute concentration of atoms was determined with a Wrede gage. The rate of recombination was measured by observing the radiation emitted as a result of the reaction of oxygen atoms with a trace of nitric oxide. An upper limit of 2.5×10^{14} cc^2/mol^2 sec was established for the rate constant at 350°K of the reaction $O + O + O_2 \rightarrow O_2 + O_2$. Since this upper limit is 1/3 to 1/2 times the value found in shock-tube experiments for the same rate constant at 3500°K, it is concluded that the rate constant increases slowly with temperature instead of varying as an inverse power of absolute temperature, as has conventionally been assumed. In the same experiments, the rate constant for the reaction $O + O_2 + O_2 \rightarrow O_3 + O_2$ was found to be 1.1×10^{14} cc^2/mol^2 sec at 350°K, in excellent agreement with other recent determinations. Recombination

was found to be strongly catalyzed by hydroxyl radicals in accordance with the mechanism $O + OH + O_2 \rightarrow HO_2 + O_2$, $O + HO_2 \rightarrow OH + O_2$. The rate constant for the first of these reactions was found to be 5×10^{16} cc^2/mol^2 sec at 300°K, from flow experiments in which water vapor was mixed with oxygen upstream from the discharge. When hydrogen peroxide vapor was injected into a stream of partly dissociated oxygen, it reacted as follows: $O + H_2O_2 \rightarrow OH + HO_2$ and the size of the diffusion flame produced yielded an order-of-magnitude estimate of 10^{12} cc/mol sec for the rate constant of this reaction at 300°K. (Contractor's abstract)

26

Aerojet-General Corp., Azusa, Calif.

RECOMBINATION PROCESSES IN ADVANCED PROPULSION SYSTEMS (Abstract), by C. B. Kretschmer. [1960] [1]p. (Bound with its AFOSR-TN-60-1063; AD 246174) (AF 49(638)540) Unclassified

Presented at First AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, General Dynamics Corp., General Atomic Div., San Diego, Calif., Sept. 6-7, 1960.

A short review of some of the gas-phase reactions investigated under this contract is presented. The objectives of the next phase of this research are briefly outlined and include an investigation of processes involved in the decay of ionization of gases. It is pointed out that the rate coefficient for the formation of diatomic ions has not been measured, though it should be possible to do so by working at suitable pressures and ion concentrations. It is also hoped that the discrepancy between recombination coefficients measured some 30 yr ago and more recent measurements can be resolved by the use of probe and microwave methods.

27

Aerojet-General Corp., Azusa, Calif.

INVESTIGATION OF THE MECHANISM OF COMBUSTION OF COMPOSITE SOLID PROPELLANTS, by D. J. Sibbett and J. M. Lobato. Final rept. Apr. 1960 [38]p. incl. illus. diagrs. table, refs. (Rept. no. 1782) (AFOSR-TR-60-64) (AF 49(638)566) AD 240274 Unclassified

An end-to-end burning technique utilizing both fuse-wire and photographic measurements was employed to determine the rates of combustion to ammonium perchlorate strands between atmospheric pressure and 1500 psi. Studies of the decomposition of perchloric acid in the gas phase between 200 and 220°C indicated that the reaction was initially second order in perchloric acid. At higher conversions, the process became first order. The reaction between ammonia and perchloric acid was examined between 25° and 60°C.

28

Aerojet-General Corp., Azusa, Calif.

STUDY OF THE KINETICS OF SOLID-PHASE REACTIONS, by R. F. Chaiken, I. Geller and others. Summary rept. Mar. 1960 [39]p. incl. illus. diagrs. refs. (Rept. no. 1769) (AFOSR-TR-60-44) (AF 49-(638)573) Unclassified

This report summarizes recent studies on sublimation and decomposition phenomena in solids. An extensive kinetic study of the sublimation of ammonium chloride has been carried out with hot-plate linear pyrolysis and bulk heating techniques. Both techniques yield the same rate constants. Two new investigations have been initiated: (1) a study of the mechanism of condensation phenomena involving solid-gas systems and (2) a phenomenological study of the thermal decomposition of single ionic crystals. (Contractor's abstract)

29

Aerojet-General Corp., Azusa, Calif.

CHARGED-COLLOID PROPULSION SYSTEM, by R. D. Schultz and L. K. Branson. Dec. 1959 [32]p. incl. illus. diagrs. tables, refs. (Rept. no. 1728) (AFOSR-TN-60-212) (AF 49(638)656) AD 230620; PB 146178 Unclassified

Theoretical and experimental research is described leading toward a space propulsion system in which microscopic oil droplets are produced with a high positive charge and accelerated electrostatically to exhaust velocities of over 50,000 mph with a specific impulse of over 2200 sec. This type of rocket system may prove to be of considerable value for controlling the orbit of an earth satellite, for earth-moon missions, and possibly for deep-space exploration such as a Mars or Venus probe. (Contractor's abstract)

30

Aerojet-General Corp., Azusa, Calif.

CHARGED COLLOID PROPULSION SYSTEM, by R. B. Edmonson, C. B. Kretschmer, and L. B. Becker. Semiannual rept. no. 2. July 1, 1960 [14]p. incl. illus. diagrs. (Rept. no. 1880) (AFOSR-TN-60-1237) (AF 49(638)656) AD 244546 Unclassified

Research on the electrostatic spraying of microscopic droplets of oil is summarized. The research is directed toward an understanding of the mechanisms of charge accumulation and electrostatic spraying in high electrical fields, an understanding which is necessary for subsequent adaptation of the phenomenon to use in

high efficiency, low-thrust propulsion applications. The work was primarily experimental and relates to the role of unattached electrons. In addition, a collection probe has been designed for the measurement of the average ratio of charge to mass. The initial results from the use of the probe indicate that a high degree of reproducibility and accuracy can be obtained in this measurement. (Contractor's abstract)

31

Aerojet-General Corp., Azusa, Calif.

CHARGED-COLLOID PROPULSION SYSTEM, by R. B. Edmonson, C. B. Kretschmer, and L. B. Becker. Nov. 1960 [13]p. incl. illus. diagrs. tables. (Rept. no. 0290-01-1) (AFOSR-TN-60-1454) (AF 49(638)656) AD 247720 Unclassified

This report summarizes research on the electrostatic spraying of microscopic droplets of oil. The research is directed toward an understanding of the mechanisms of charge accumulation and electrostatic spraying in high electrical fields. This understanding is necessary for subsequent adaptation of the phenomenon to use in high-efficiency, low-thrust propulsion applications. The work during this period has been directed primarily to the measurement of charge-to-mass ratios and particle size distributions. Effective spraying of Octoil with an additive of tetra-n-butyl ammonium has been attained at a pressure of 10^{-6} mm Hg utilizing a porous non-conductive element for feeding the liquid propellant oil mixture. (Contractor's abstract)

32

Aerojet-General Corp., Azusa, Calif.

INVESTIGATIONS OF THE MECHANISMS OF DECOMPOSITION, COMBUSTION AND DETONATION OF SOLIDS (Abstract), by R. F. Chaiken, J. F. Cheselske and others. [1960] [4]p. (AF 49(638)851) Unclassified

Presented at AFOSR Second Contractors' meeting on Solid Propellant Combustion, Atlantic Research Corp., Alexandria, Va., June 7-8, 1960. (AFOSR-TN-60-663; AD 239150)

Some of the more recent work on the chemical processes which occur during the thermal decomposition, combustion and detonation of solids is reported. The sublimation of ammonium halides was studied by utilizing the hot-plate pyrolysis technique, as well as a conventional isothermal vacuum bulk measurement technique which enabled data to be obtained on rates of sublimation which differed by as much as a factor of 10^4. A description of the mechanism of decomposition of solid ammonium perchlorate is presented. On the basis of this work, it is currently believed that the crystalline material decomposes by two competing reactions, one exothermic in nature and the other endothermal. It is proposed that the exothermal reaction, which occurs in the intermosiac structure of the crystal mass, proceeds by an electron transfer process while the endothermal reaction, which occurs in the mosaic structure and involves dissociative sublimation, proceeds by a proton transfer process. A study of the decomposition of anhydrous $HClO_4$ was undertaken by following pressure-time changes during the heating stage. It was found that the reaction occurs by a second order homogeneous process followed by a first order process. Burning rate studies of strands of propellant materials carried out in a window bomb are reported on also. Also included in the research was the application of surface decomposition kinetics to the Eyring Grain Burning Theory of Detonation and a study of the bulk compression detonation of explosives.

33

Aeronautical Research Associates of Princeton, Inc., N. J.

BEHAVIOR OF SOLUTIONS OF THE NAVIER-STOKES EQUATIONS FOR A COMPLETE CLASS OF THREE-DIMENSIONAL VISCOUS VORTICES, by C. duP. Donaldson and R. D. Sullivan. May 1960 [28]p. incl. diagrs. table, refs. (AFOSR-TN-60-172) (AF 49(638)-255) AD 237527; PB 148027 Unclassified

Also published in Proc. of 1960 Heat Transfer and Fluid Mechanics Inst., Stanford U., Calif. (June 15-17, 1960), Stanford U. Press, 1960, p. 16-30.

A study was made of the complete class of solutions of the Navier-Stokes equations wherein the radial, tangential, and axial velocities in cylindrical coordinates (r, θ, z) are the forms $u = u(r)$, $v = v(r)$, and $w = z\bar{w}(r)$. These solutions are found to represent a rather large class of 3-dimensional viscous vortex motions. The class of solutions contains Burgers' analytic solution for an unconstrained 1-celled vortex as a special limiting case. The solutions show that vortex motions are possible which have more than 1 cell, i.e., the flow may not simply spiral in toward an axis and out along it as in a 1-celled configuration but may have nested regions of successively reversed axial flow. The behavior of the solutions in passing from single to multiple-celled configurations is discussed. The solution for the case of a 2-celled analogue to Burgers' unconstrained vortex, which occurs often in nature, is given in closed form. An outcome of the investigation is that, for a given narrow range of dimensionless parameters governing the flow, no steady solutions of the Navier-Stokes equations of the type under investigation are possible. (Contractor's abstract)

34

Aeronautical Research Associates of Princeton, Inc., N. J.

EXAMINATION OF THE SOLUTIONS OF THE NAVIER-STOKES EQUATIONS FOR A CLASS OF THREE-

DIMENSION[illegible] VORTICES. PART I. VELOCITY DISTRIBUTI[illegible]S FOR STEADY MOTION, by C. duP. Donaldso[illegible] R. D. Sullivan. Oct. 1960, 82p. incl. diagrs. [illegible]les, refs. (AFOSR-TN-60-1227) (AF 49-(638)255) AD 247471 Unclassified

A study was made of the class of solutions of the Navier-Stokes equations wherein the radial, tangential, and axial velocities in cylindrical coordinates (r, θ, z) are of the forms u = u(r), v = v(r), and w = z$\bar{w}$(r). These solutions are found to represent a rather large class of 3-dimensional viscous vortex motions. The class of solutions contains Burgers' analytic solution for an unconstrained 1-celled vortex as a special limiting case. The solutions obtained show that vortex motions are possible which have more than 1 "cell". That is, the flow may not simply spiral in toward an axis and out along it as in a 1-celled configuration but may have nested regions of successively reversed axial flow. The behavior of the solutions in passing from single to multiple-celled configurations is discussed and the solution for the extremely interesting case of a 2-celled analogue to Burgers' unconstrained vortex, which probably occurs quite often in nature, is given in closed form. An interesting outcome of the investigation which is discussed is that, for a given narrow range of dimensionless parameters governing the flow, no steady solutions of the Navier-Stokes equations of the type under investigation are possible. This report is an elaboration of item no. 33, Vol. IV.

35

Aeronautical Research Inst. of Sweden, Stockholm.

AN EXPERIMENTAL INVESTIGATION OF SUPERSONIC WING-BODY INTERFERENCE AND COMPARISON WITH SECOND-ORDER, by G. Drougge and M. T. Landahl. Dec. 1959 [24]p. incl. illus. diagrs. tables. (Technical note no. 2) (AFOSR-TN-60-257) (AF 61-(052)75) AD 233377; PB 145854 Unclassified

In Technical note no. 1 (item no. 26, Vol. III) and in a paper (item no. 39, Vol. IV), approximate 2nd-order solutions for the supersonic flow around wing-body combinations were calculated and applied to certain configurations. In order to test the theory, wind-tunnel experiments on non-lifting cone-cylinder bodies in combination with wings of simple shape were performed at M = 3 and M = 4. This investigation was described and some of the results were given in (item no. 26, Vol. III). The present report is a somewhat more complete version of the experimental investigation and includes also the comparisons with theory made in item no. 26, Vol. III. (Contractor's abstract, modified)

36

Aeronautical Research Inst. of Sweden, Stockholm.

SOME RESULTS FROM AN INVESTIGATION OF INTERFERENCE EFFECTS AT HIGH SUPERSONIC SPEEDS, by G. Drougge and P. [G.] Wilby. [1960] 9p. incl. diagrs. (AFOSR-TN-60-611) (AF 61(052)75) Unclassified

The results of experiments of the interference from the cone-cylinder field on the wings at angles of attack are presented. The experimental results are compared with the 2nd-order theory, which gives a quite good agreement outside of the Mach cone from the wing apex. To check the 2nd-order theory, the pressure difference at the leading edge was also computed by means of the exact oblique shock-wave solution for swept wings. The results show that the 2nd-order theory agrees with the exact values, which in turn agree very well with the experiments. The interference effects on the suction side have rather small absolute values, so the distributions' pressure coefficient may be said to be representative also of the pressure difference between the pressure and suction side of the wing. From the results shown, it may also be concluded that the agreement with theory is better at M = 4 than M = 3. It is also clear that the 2nd-order interference is rather large and has to be included in computations of interference effects, if accuracy is wanted.

37

Aeronautical Research Inst. of Sweden, Stockholm.

THE INTERFERENCE BETWEEN TWO INTERSECTING PERPENDICULAR TWO-DIMENSIONAL SUPERSONIC FLOW FIELDS, by M. T. Landahl. July 1960, 19p. incl. diagrs. (FFA rept. AU-II-93:3; technical note no. 3) (AFOSR-TN-60-1473) (AF 61(052)75) AD 252804; PB 155288 Unclassified

As a simplified model for wing-body interference, the 2nd-order problem for the supersonic flow about 2 intersecting perpendicular 2-dimensional wings is solved. Formulas are given for the 2nd-order interference pressure. By neglecting the effects of velocity gradients, a simplified formula is deduced which is found to give results in good agreement with the more exact theory. At high Mach numbers this formula agrees with the one obtained by B. Beane and M. Landahl, 1959 (see item no. 26, Vol. III). (Contractor's abstract)

38

Aeronautical Research Inst. of Sweden, Stockholm.

AN EXPERIMENTAL AND THEORETICAL INVESTIGATION OF SECOND-ORDER SUPERSONIC WING-BODY INTERFERENCE, FOR A NON-LIFTING BODY WITH WINGS AT INCIDENCE, by P. G. Wilby. Oct. 1960 [11]p. incl. diagrs. (Technical note no. 4; rept. no. 87) (AFOSR-419) (AF 61(052)75) AD 251340 Unclassified

Pressure distributions on the wing of 2 wing-body

combinations are measured experimentally at Mach numbers 3 and 4 with the wing at various incidences in the range 0° to 10°. The results are compared with theoretical results which include interference effects calculated according to the 2nd-order supersonic wing-body interference theory due to Landahl and Beane. This theory is tested for wings at incidence. The agreement between theory and experiment is found to vary with Mach number and wing sweepback. For the higher Mach number and moderate sweepback the theory gives a good prediction of pressure distribution, but for the most adverse condition of low Mach number and large sweepback the theory is found to overestimate the interference effects. This is expected as the theory assumes the sweepback of the wings is small compared with that of the Mach line. An empirical guide to the limit of application of the interference theory is given. Within this limit the agreement between theory and experiment is found to deteriorate only a little with increase of incidence, over the range tested. (Contractor's abstract)

39

Aeronautical Research Inst. of Sweden, Stockholm.

THEORETICAL AND EXPERIMENTAL INVESTIGATION OF SECOND-ORDER SUPERSONIC WING-BODY INTERFERENCE, by M. [T.] Landahl, G. Drougge, and B. [J.] Beane. [1960] [9]p. incl. illus. diagrs. (AF 61(052)75) Unclassified

Presented at Nat'l. summer meeting of the Inst. Aeronaut. Sci., Phenomena of Transonic and Supersonic Flow Session, Los Angeles, Calif., June 16-19, 1959.

Published in Jour. Aero/Space Sci., v. 27: 694-702, Sept. 1960.

In technical note no. 1 of this contract (item no. 26, Vol. III) an approximate solution for the 2nd-order supersonic flow problem of 2 interfering flow fields was given. This published paper continues that search at Mach pressure of M = 3 and M = 4. Approximate 2nd-order solutions for the supersonic flow around wing-body combinations are calculated, using 2 different theoretical models. In the first, the span-wise curvature of the body field is assumed small and the wing sweep small in comparison with that of the Mach cone. In the second, 2 perpendicular intersecting 2-dimensional fields are considered. The analysis is restricted to such high Mach numbers that $M^{-2} \ll 1$, and an approximate formula common to the 2 models is then found for the 2nd-order interference term. This formula can also be used to correct experimental pressure distributions for the effect of nonuniformities in the wind-tunnel flow. In order to test the theory, wind-tunnel experiments on nonlifting cone-cylinder bodies in combination with wings of simple shapes were performed. Pressure distributions were measured at M = 3 and M = 4, both around the bodies, and it was found that the 2nd-order interference was predicted reasonably well by the simplified theory. (Contractor's abstract)

40

Aeronutronic, Newport Beach, Calif.

STUDY OF INFLUENCE OF SOUND WAVES ON CHEMICAL REACTION RATES, by H. M. Wight. Final rept. Mar. 31, 1960, 46p. incl. diagrs. tables, refs. (Technical rept. no. U 858) (AFOSR-TR-60-60) (AF 49(638)311) AD 237573; PB 147936 Unclassified

A study was made of the interaction of sound waves and homogeneous gas phase chemical reactions involving: (1) the enhancement of reaction rates by sound waves, and (2) the amplification or absorption of a traveling sound wave by a gas phase reaction. Theoretical analyses were made of rate enhancement for HI decomposition, generalized chain reactions, and HBr synthesis chain reaction. The analyses predict an acoustical enhancement of chemical reaction rates in the gas phase. The actual enhancement will be negligible except under the action of extremely intense sound waves. The falloff in rate enhancement for chain reactions as a function of increasing sound frequency is expected to be very mild. Direct experimental verification by the bellows technique was virtually impossible due to surface reactions, temperature shifts in the system, and other factors. Other pressure perturbation techniques did not appear promising. The effect of a chemical reaction in the gas phase was negligible with regard to acoustic transmission characteristics of the medium. That homogeneous gas phase reactions have a primary role in the problem of rocket motor resonant combustion is doubtful.

41

Air Force Office of Scientific Research, Washington, D. C.

PLASMA ACCELERATORS, by M. M. Slawsky. [1960] 7p. incl. refs. (AFOSR-TN-60-1030) AD 243347 Unclassified

Also published in I.R.E. Trans.; Fifth Nat'l. Symposium on Space Electronics and Telemetry, Washington, D. C. (Sept. 19-21, 1960), New York, Institute of Radio Engineers, 1960, p. 3-3.

The research effort in plasma acceleration for propulsion can be viewed with respect to the fundamentals of the propulsion problem. The major objectives are the efficient production of plasma velocity and thrust. Since plasma accelerators can be thought of as electric motors the various acceleration concepts are presented as shunt, series or induction devices. The basic phenomena of interaction between the magnetic field and the current carrying plasma are related to the energy density $B^2/2\mu$ in the magnetic field. Since detailed descriptions of the various accelerators appear in the literature cited, only the basic principles

and a summary of the performance that has been achieved are presented for each group. It appears that the plasma accelerator analogous to series motors is the furthest along in crystallization of ideas. The one with the greatest potential, however, appears to be that analogous to the induction motor. For all concepts, the future depends on what can be done about the containment of plasma and increasing efficiency in converting electromagnetic energy into the kinetic energy of the plasma. The solution to these problems will require a deeper understanding of plasma physics. (Contractor's abstract)

42

Air Force Office of Scientific Research, Washington, D. C.

AIR FORCE RESEARCH ON LIVING PROTOTYPES, by H. E. Savely. Sept. 1960, 7p. (AFOSR-TN-60-1189) Unclassified

Also published in Bionics Symposium, Dayton, Ohio (Sept. 13-15, 1960), Wright-Patterson Air Force Base, Wright Air Development Div., 1960, p. 41-47. (WADD-TR-60-600)

A brief discussion of three inter-related aspects of the nervous system is presented. These are: (1) the sensory receptors of animals, (2) the integrative action of their nervous systems, and (3) the storage and retrieval of information. Many of the lesser known sensing devices are discussed such as the infrared sensing organ of the rattlesnakes, the electrical energy sensing organs of some fishes, the chemical sensing organs of the vertebrates, and the hearing devices of the owl, bat, and moth. It is pointed out that there are undoubtedly many undiscovered sensory organs as well as many anatomical structures to which scientists have failed to ascribe a function. As complex as this aspect of research may be, it fails to even reach the complexity of studying the integration of the impulses that these organs sent to the central nervous system. The central nervous system must carry out digital to analogue conversions of the signal for the purpose of analysis and mixing with other disturbances of the nervous system. It is hoped that by understanding the simpler situations that can be studied in the lower animals that the more complex human central nervous system integrative action can be understood. Finally, it is pointed out that far too little can be said of how the nervous system stores and retrieves information. Nevertheless, it is expected that once a better understanding of these problems can be achieved, their application of problems of engineering can be readily handled.

43

Air Force Office of Scientific Research, Washington, D. C.

VISTAS IN ASTRONAUTICS, VOLUME III. PROCEEDINGS OF THE THIRD ANNUAL AIR FORCE OFFICE OF SCIENTIFIC RESEARCH ASTRONAUTIC SYMPOSIUM, Los Angeles, Calif., Oct. 12-14, 1960, ed. by E. R. van Driest, C. W. Guy and others. New York, Society of Automotive Engineers, 1960, 266p. incl. illus. diagrs. tables, refs. (AFOSR-1944) (Sponsored jointly by Air Force Office of Scientific Research and Society of Automotive Engineers) Unclassified

This third AFOSR Astronautic Symposium was divided into six functional sessions which dealt with astronautic vehicle utilization, astronautic propulsion, bioastronautics, planetary and space environment, astronautic communications, and astronautic guidance. The speakers were grouped together under these functional areas to discuss such topics as military space problems, Venus exploration, electrical propulsion, manned flights, interplanetary conditions, communication satellites and rendezvous systems. It was hoped that interest in these areas would justify preserving the proceedings in permanent form.

44

Air Force Office of Scientific Research, Washington, D. C.

SURFACE EFFECTS ON SPACECRAFT MATERIALS; FIRST SYMPOSIUM, Palo Alto, Calif., May 12-13, 1959, ed. by F. J. Clauss. New York, Wiley and Sons, 1960, 404p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research and Lockheed Aircraft Corp.) Unclassified

This symposium was directed at reviewing the problems of moving hardware around in space and the various solutions that were being tested in order to overcome those problems. The reports included research on the effects of radiation and temperature on surfaces, coating for space vehicles, measuring thermal emittance, high vacuum problems, and ultraviolet radiation effects.

45

Alabama U., University.

A STUDY OF THE CHEMISTRY OF NIOBIUM AND ITS RELATED ELEMENTS, by J. L. Kassner. Final rept. July 31, 1960, 14p. incl. tables, refs. (AFOSR-TR-60-99) (AF 18(600)1567) AD 251857 Unclassified

The possibility of using 4-methylnioxime as a chelating reagent for Re was explored. The method developed was based on the formation of a soluble, stable, yellow-green rhenium-4-methylnioxime chelate, where Re (VII) is reduced by $SnCl_2$ in a dilute HCl solution in the presence of 4-methylnioxime. The calculated molar extinction coefficient for rhenium-4-methylnioxime is 6.89×10^4. This method is applicable to the spectrophotometric determination of less than 0.001% to more than 1.0% of rhenium in molybdenite concentrate and in molybdenite roaster flue dust.

46

Alabama U., University.

SPECTROPHOTOMETRIC DETERMINATION OF RHENIUM WITH 4-METHYLNIOXIME, by J. L. Kassner, S.-F. Ting, and E. L. Grove. [1960] [7]p. incl. tables, refs. (AFOSR-3792) (AF 18(600)1567) Unclassified

Also published in Talanta, v. 7: 269-275, 1961.

A simple method applicable to the spectrophotometric determination of less than 0.001% to more than 1.0% of rhenium in molybdenite concentrate and in molybdenite roaster flue dust has been developed. Interfering elements commonly found in these materials are removed in three operations: evaporation with hydrochloric acid, precipitation of hydrous oxides with ammonia, and formation of organometallic compounds with ethyl xanthate and chloroform extraction. The method is based on the formation of a soluble, stable, yellow-green rhenium-4-methylnioxime chelate where rhenium^{VII} is reduced by tin^{II} chloride in a dilute hydrochloric acid solution in the presence of 4-methylnioxime (4-methyl-1:2-cyclohexanedionedioxime). The color develops in less than 5 min and the chloroform extract shows a maximum absorption at 436 mμ. The calibration curve conforms to Beer's law. The molar extinction coefficient for rhenium-4-methylnioxime is about 6.89×10^4 as compared to less than 4.5×10^4 reported for other methods for rhenium. (Contractor's abstract)

47

Alabama U., University.

AN INEXPENSIVE APPARATUS FOR SOLUBILITY MEASUREMENTS, by R. H. Schmitt and E. L. Grove. [1960] [1]p. incl. diagr. (AFOSR-3802) (AF 18(600)-1567) Unclassified

Also published in Jour. Chem. Education, v. 37: 150, Mar. 1960.

The simple construction of a device for the measurement of solubility is described. The device consists of a 100 ml bottle to whose cap is welded a strip of polyethylene so that the system can be suspended with a wire from a variable speed motor. When small quantities of solution are used the bottle should be weighted and this can be accomplished by using a piece of 1 7/8 in. lead pipe or a few turns of lead wire slipped on or off the bottle as needed. Effective stirring is accomplished by the use of an ordinary plastic-covered magnetic stirring bar in the bottle and a more powerful magnet below the bottle. The magnets are held stationary while the bottle is rotated.

48

Alabama U., University.

THE EQUIVALENT CONDUCTANCE OF THE HEXAFLUOROCOMPLEXES OF GROUP IV (Si, Ge, Sn, Ti, Zr, Hf), by R. H. Schmitt, E. L. Grove, and R. D. Brown. [1960] [4]p. incl. diagrs. tables, refs. (AF 18-(600)1567) Unclassified

Published in Jour. Amer. Chem. Soc., v. 82: 5292-5295, Oct. 20, 1960.

The limiting equivalent conductance values were determined for the hexafluorocomplex ions of 6 elements in Group IV. The plot for the uncorrected equivalent conductances of several concentrations of the potassium, rubidium and cesium salts vs $C^{\frac{1}{2}}$, where C is concentration in equivalents per liter, yields the curve of a typical weak electrolyte. However, cryoscopic determinations carried out with 0.01, 0.02 annd 0.03 molar hexafluorocomplex compounds in aqueous solution indicate that 3 ions are formed for each molecule of salt present. In addition, the pH values were found to be relatively constant for the concentration ranges from 10^{-1} to 10^{-4} equivalent per liter. From the above observations the following equilibria were postulated where the symbol M represents an element of Group IV. For the potassium salt the dissociation is represented as $K_2MF_6 \rightleftharpoons 2K^+ + MF_6^{-2}$. Then due to the competition of hydroxyl ions with the fluoride ions as substituents in the coordination sphere of the hexafluorocomplexes $MF_6^{-2} + 2n\ HOH \rightleftharpoons MF_{6-n}(OH)_n^{-2} + nF^- + nH_3O^+$. The value of n is small and results indicate that this reaction does go to completion. If n becomes large, as upon the addition of OH^-, then $H_3O^+ + F^- \rightleftharpoons HF + H_2O$.

49

Alfred U. New York State U. Coll. of Ceramics, N. Y.

DIFFUSION, CONDUCTION AND F-CENTER FORMATION IN IONIC SOLIDS, by T. J. Gray, [illegible] G. Harrison, and R. W. Petticrew. Final rept. Oct. 31, 1960, 1v. incl. diagrs. tables, refs. (AFOSR-122) (AF 18(600)-1448) AD 250851; PB 171267 Unclassified

This program was designed to establish a clearer understanding of the more complex relationships associated with diffusion in ionic solids. An attempt was made to correlate ionic conduction with the defect constitution of the solid, more specifically as affected by the aggregation of impurities at dislocations and other interfaces. The rate of formation of F-centers was studied as a function of the thermal history of a variety of pure and controlled-impurity alkali halides, particularly NaCl. At room temperature, the saturation F-center density depended on the intensity of the coloring radiation because of a variation in the fraction of

initially present vacancies that can be converted to F-centers by irradiation. The variation was in turn due to the fact that the ability of the irradiation to produce permanent breakup of vacancy complexes depends on the intensity of the radiation.

50

Alfred U. New York State U. Coll. of Ceramics, N. Y.

DIELECTRIC LOSSES DUE TO DISLOCATIONS IN SAPPHIRE, by D P. Detwiler and N. M. Tallan. June 29, 1960, 177p. incl. diagrs. tables, refs. (AFOSR-TN-60-884) (AF 49(638)87) AD 245899; PB 152044 Unclassified

A Schering Model 716-C capacitance bridge was used to investigate the dielectric properties of sapphire at frequencies between 100 and 10,000 c and temperatures between -160 and 400°C. The samples studied were oriented windows of clear sapphire in the form of disks about 0.75 in. in diam and 0.020 in. thick, oriented either perpendicular or parallel to the optic axis. Dielectric loss maxima were observed, and the loss process was more pronounced with the optic axis in the direction of the applied field than with the optic axis perpendicular to the field. The temperature dependence of the frequency corresponding to the loss maxima observed was found to obey an expression of the form $\frac{1}{\omega_{max}} = Ae^{B/T}$. Values of the activation energy and time constant were calculated for each of experimentally obtained loss curves. The value of the activation energy decreased while the time constant increased with heat treatment at 400°C. When the sample was exposed to dry H, a dilute acid, or a moist atmosphere directly opposite effects were observed. It is postulated that H enters the crystal lattice along dislocation lines and is bound to the dislocations within the region of dilational strain associated with them.

51

Alfred U. New York State U. Coll. of Ceramics, N. Y.

ANOMALOUS DIELECTRIC LOSS IN Al_2O_3 (Abstract), by N. M. Tallan and D. P. Detwiler. [1960] [1]p. [AF 49(638)87] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 49, Jan. 27, 1960.

Measurements have been made in vacuum between -160°C and 400°C, of the dielectric loss of Linde flame-fusion grown single crystal Al_2O_3 at frequencies between 100 cps and 100,000 cps. A characteristic loss peak is found in this region, whose activation energy and position on the temperature scale are dependent upon the previous treatment of the specimen. Exposure to moist air, dry hydrogen, or HCl solution results in a large, broad loss peak near 400°C with an activation energy of approximately 0.5 ev. Heating in vacuum at 400°C results in a gradual sharpening of the loss maximum, together with a progressive shift to lower temperature, diminution of amplitude, and decrease of activation energy to a final value of about 0.3 ev. These changes are reversible. This behavior is attributed to the penetration of hydrogen along dislocation lines and its binding in the strained regions of the lattice surrounding the dislocations.

52

Alfred U. New York State U. Coll. of Ceramics, N. Y.

THE ADSORPTION OF OXYGEN ON ZINC OXIDE AND ZINC SULFIDE AND THE EFFECT OF PHOTOEXCITATION UPON THESE PROCESSES, by D. Waksman. June 7, 1959 [33]p. incl. diagrs. refs. (AFOSR-TN-60-410) (AF 49(638)288) AD 237271 Unclassified

An investigation was undertaken to study the adsorption of oxygen on zinc oxide and zinc sulphide, in both pure and in copper activated forms. A study of the effects that irradiation of the samples with light from a carbon arc lamp had upon the adsorption processes was also studied, as a prelude to further investigation of the effects of photoexcitation using monochromatic light. It was found that oxygen was chemisorbed on all of the samples studied. Illumination of the pure zinc oxide sample caused a reversible photo-desorption, probably due to the attraction of positive holes to the surface of the oxide. The copper activated zinc oxide was found to exhibit a photo-adsorption first, and then a photo-desorption. The process was found to be reversible upon cessation of illumination. This is probably due to first exciting electrons from the copper luminescence centers, and then the attraction of position holes to the surface combined with thermal quenching. Pure zinc sulphide was found to exhibit an irreversible photo-desorption upon irradiation. This is most likely due to an irreversible photochemical reaction between oxygen and defects in the bulk material. The copper activated zinc sulphide exhibited the same properties as the activated zinc oxide and the explanation is probably similar for the photo-adsorption, but the photo-desorption was probably due to thermal quenching. The broad radiation range that the arc lamp produced probably caused the observation of two effects in the activated samples. Thermal quenching of the materials no doubt occurred simultaneously with photo-excitation of copper luminescence centers.

53

Alfred U. New York State U. Coll. of Ceramics, N. Y.

CHEMICAL-PHYSICS OF CATALYST SURFACES, by T. J. Gray. [1959] [17]p. incl. diagrs. refs. (AFOSR-TN-60-413) (AF 49(638)288) AD 236720; PB 147495 Unclassified

Presented at meeting of the Petroleum Chem. Div. of the Amer. Chem. Soc., Boston, Mass., Apr. 5-10, 1959.

Abstract published in 135th meeting of the Amer. Chem. Soc., Abstracts of Papers, 1959, p. 9-Q.

A model is presented representing the electronic constitution of the surface of a catalyst based on the band theory of solids. It follows implicitly that there will be a direct correlation with any process involving a variation of the electron cloud distribution as occurs during chemisorption and reaction processes. Measurements of the electronic properties of the surface region of catalysts under dynamic conditions afford valuable indirect methods for determining the kinetics of adsorption, reaction and desorption processes in great detail. The model leads to the possibility of qualitative prediction of the action of certain promoters and suggests possible ways of modifying selectivity. The model is general in applicability and covers photocatalytic processes which are demonstrated to make possible the applicational use of high efficiency photochemical processes. Direct correlation is suggested with the photocatalytic syntheses in biochemical reactions. (Contractor's abstract)

54

Alfred U. [New York State U. Coll. of Ceramics] N. Y.

A STUDY OF THE CORRELATION BETWEEN THE DEFECT SOLID STATE AND CATALYSIS, by T. J. Gray. Annual summary rept. Feb. 1959-Feb. 1960 [16]p. incl. diagrs. refs. (AFOSR-TN-60-557) (AF 49-(638)288) AD 236721; PB 147496 Unclassified

The effects of radiation from a carbon arc on the adsorption of oxygen on zinc oxide and zinc sulfide (in both pure and copper-activated forms) were studied. It was shown that oxygen was chemisorbed on all samples examined. Pure and copper-activated zinc oxide exhibited reversible photodesorption, preceded in the latter case by an initial photoadsorption. Pure zinc sulfide exhibited irreversible photoadsorption but the copper-activated sulfide was qualitatively analogous to the activated oxide. Preliminary experiments indicate that ethylene may be polymerized over irradiated zinc oxide and apparatus has been constructed to extend these observations and to examine the oxidation and hydrogenation of organic materials in the vapor phase over irradiated zinc oxide. (Contractor's abstract)

55

Alfred U. New York State U. Coll. of Ceramics, N. Y.

DEFECT STRUCTURE AND CATALYSIS, by T. J. Gray. [1960] [16]p. incl. diagrs. refs. (AFOSR-TN-60-644) (AF 49(638)288) AD 243545; PB 152344 Unclassified

Also published in Actes Deuxième Cong. Internat'l. de Catalyse, Paris (France) (July 1960), Paris, Editions Technip, 1961, p. 1561-1571.

A detailed general model for a catalyst surface based on electron energy states in a semiconducting solid is presented leading to the development of a broad qualitative theory of electron transfer processes at catalyst surfaces. Correlation between semiconducting, photoconducting, and magnetic properties during the adsorption, reaction, and desorption processes are established experimentally. These relationships are employed to induce modified catalytic properties in a variety of materials. The significance of photo-excitation of electrons is considered in relation to photo-adsorption, photo-desorption, and photo-catalytic phenomena, particularly polymerization. (Contractor's abstract)

56

Allied Research Associates, Inc., Boston, Mass.

NONSTEADY INCOMPRESSIBLE HEAT TRANSFER FOR ARBITRARY BODIES AND ALL PRANDTL NUMBERS, by T. R. Goodman. Sept. 1, 1960, 24p. incl. diagrs. refs. (AFOSR-TN-60-843) (AF 49(638)839) AD 242475 Unclassified

The problem is solved of nonsteady incompressible heat transfer for arbitrary bodies and all Prandtl numbers, using an integral method, and ignoring viscous dissipation. A partial differential equation is derived which yields as special cases Lighthill's non-uniform heat transfer formula and the nonsteady heat conduction in a slab. The differential equation is then specialized to the nonsteady but uniform heat transfer on a flat plate. Comparisons with other solutions are made when available, and it is shown that the integral method produces accuracy of a few percent in these limiting cases. Finally, the heat transfer formula which was derived is used to calculate the temperatures in a thin skin subject to a jump in external velocity. (Contractor's abstract)

57

American Inst. for Research, Pittsburgh, Pa.

A SURVEY OF CUEING METHODS IN EDUCATION AND IN AUTOMATED PROGRAMS, by L. J. Briggs. May 1960, 29p. incl. refs. (Research rept. no. AIR-314-60-TR-106) (AFOSR-TN-60-286) (AF 49(638)681) AD 238967; PB 153460 Unclassified

Methods used by teachers and writers of auto-instructional programs in cueing or prompting students to maximize the likelihood of their giving the correct responses to instructional exercises are discussed. The use of direct prompts versus less direct forms of cueing is discussed and illustrated. The relative absence of evidence on cueing technique from studies in the experimental laboratory is noted. Teacher techniques in starting with minimal cueing and proceeding to more

direct prompts are pointed out, and prompting features of some training devices are described. Crowder's intrinsic programming method is discussed from the standpoint of cueing. Specific cueing techniques used in Skinner-type programs by Holland and others are illustrated and briefly commented on. (Contractor's abstract)

58

American Inst. for Research, Pittsburgh, Pa.

A SURVEY OF CUEING METHODS IN EDUCATION AND IN AUTOMATED PROGRAMS (Appendix I), by J. E. Llewellyn and L. J. Briggs. May 1960, 13p. incl. diagrs. (AFOSR-TN-60-286a) (Bound with its AFOSR-TN-60-286; AD 238967 as Appendix I) (AF 49(638)681) Unclassified

Some comments on programs and sample sequences to illustrate suggested features for new programs are presented. A typical sequence would consist of first a program. This would be followed by a "wide step" to frame 2 in order to ascertain how many participants had digested the program. Frame 2.1 would be directed at those who could not get frame 2. This would again be followed by another "wide step" in frame 3, and then another "small step" for those who had not understood frame 3. Each program is directed at children of a particular school level.

59

American Inst. for Research, Pittsburgh, Pa.

PROMPTED PLUS UNPROMPTED TRIALS VERSUS PROMPTED TRIALS ALONE IN PAIRED-ASSOCIATE LEARNING, by D. Angell and A. A. Lumsdaine. Oct. 1960, 19p. incl. diagrs. tables, refs. (Research rept. no. AIR-314-60-IR-129) (AFOSR-TN-60-808) (AF 49(638)681) AD 247638; PB 153497 Unclassified

An experiment is reported which was concerned with the use of a partial degree of prompting as compared with complete prompting. It can be viewed as an initial experimental investigation of the efficacy of partial or incomplete prompting, in which the incompleteness of prompting is a matter of the frequency with which prompting is provided to the learner, rather than (as in subsequent experiments) being a matter of the degree of prompting provided to the learner on any one trial. The basic comparison was between two groups, one of which received prompting on all trials in learning a set of paired associates, and one of which practiced responding without prompting on every fourth trial. The paired-associate learning materials and the intra-trial stimulus-response time intervals were substantially the same as those employed by Cook. The results showed that learning was significantly more efficient under the experimental condition of incomplete prompting than under conditions of complete prompting. This result is in accordance with the theoretical predictions outlined in a paper by Lumsdaine, and is in contradiction to the interpretation derived from previous studies, that maximum prompting represents the optimal condition. (Contractor's abstract)

60

American Inst. of Physics, Inc., New York.

PROCEEDINGS OF THE CONFERENCE ON STRONG INTERACTIONS, California U., Berkeley, Dec. 27-29, 1960. New York, Amer. Inst. of Phys., 1961 [144]p. incl. illus. diagrs. tables, refs. (AFOSR-1338) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)983 and Atomic Energy Commission) AD 262509 Unclassified

Also published in Rev. Modern Phys., v. 33: 355-498, July 1961.

The papers given at the conference on Strong Interactions are presented. They do not represent a comprehensive or well-balanced review of the subject and have for the most part been modified since reviewed in written form by the speakers. The subject matter dealt with polarization and cross-section experiments, partial cross-sections, elastic scattering, nuclear interactions, anti-proton systems, pion-hyperon resonances, and thresholds of interactions.

61

Arkansas U. Dept. of Chemistry, Fayetteville.

MECHANISM OF THE ISOTHERMAL DECOMPOSITION OF POTASSIUM PERCHLORATE, by K. H. Stern and M. Bufalini. [1960] 6p. incl. diagr. table. (AFOSR-TN-60-749) (Bound with its AFOSR-TR-60-171; AD 248496) (AF 49(638)653) Unclassified

Also published in Jour. Phys. Chem., v. 64: 1781-1782, Nov. 1960.

The exchange between an O^{18} atmosphere and decomposing $KClO_4$ has been studied and found to be negligible.

The rate determining step of the decomposition is the removal of atomic oxygen from the perchlorate ion.

62

Arkansas U. Dept. of Chemistry, Fayetteville.

HIGH TEMPERATURE ELECTROCHEMISTRY, by K. H. Stern. Final rept. [1960] [16]p. incl. diagrs. (AFOSR-TR-60-171) (AF 49(638)653) AD 248496; PB 153827 Unclassified

The kinetics of the reaction between metallic Ag and NaCl were investigated by both conventional and EMF techniques in an oxygen and oxygen-free system. No

difficulties occurred except at very low Ag concentrations. A plot of EMF vs the logarithm of the normality of Ag shows that the Pt electrode of the cell becomes quasi-reversible to Ag when the concentration reaches about 0.006 mol fraction. An EMF-time plot shows that the same rates are obtained in air and pure O and that the quasi-reversible behavior is obtained after about 100 min. In the presence of O, metallic Ag is oxidized to Ag ion which dissovles in the melt. The oxidation rate is fairly independent of temperature between 820° and 950°C and nearly independent of O partial pressures between 0.2 and 1 atm. The EMF method can be used to measure the oxidation rate of Ag applicable to molten chlorides and other salts when the oxidation product is soluble in the melt. Cl, Pt, and Na reference electrodes give the same reaction rate.

63

Arkansas U. Dept. of Physics, Fayetteville.

ATOMIC SPECTROSCOPIC INVESTIGATION OF NUCLEAR PROPERTIES, by R. H. Hughes. Feb. 1960 [20]p. incl. illus. diagrs. tables, refs. (AFOSR-TR-60-28) (AF 18(603)26) AD 233294; PB 146753 Unclassified

A study of the isotope shifts in the atomic spectra of the medium-weight elements was undertaken. On the study of molybdenum, an attempt was made to correlate quantitatively the nuclear deformation parameter with isotope shifts in molybdenum. This attempt failed. The expected large shift between isotopes having neutron numbers 52 and the magic number 50 was borne out by the size of the 94-92 shift in molybdenum. In both Mo and Ru the 56-54 shift represents a minimum shift. It is to be noted that if the neutron $4d_{5/2}$ subshell is filled after the closure of the shell at 50, then a minimum deformation would be expected at neutron number 56. The closing of this subshell might explain the behavior of the Mo and Ru shifts at this number. It is shown that a correlation exists between the slopes of the connecting lines on the isotope-shift plot and the slopes of the connecting lines on the nuclear-binding-energy plot. With the exception of 104-102 data on Pd and the recently measured Te shifts $(K \xi T)^{12}$, whenever there is an increase in the slope of the binding-energy plot there is an increase in the slope of the isotope-shift plot for corresponding neutron number pairs and vice-versa. It is pointed out that Ce 142-140 and Nd 144-142 correlate in the opposite sense. Explanation of the above correlations is explained on the basis of nuclear deformation.

64

Arkansas U. Dept. of Physics, Fayetteville.

ISOTOPE SHIFTS IN PALLADIUM, by R. H. Hughes and F. A. Sharpton. [1960] [2]p. incl. tables. (AFOSR-3549) (AF 49(638)547) Unclassified

Also published in Phys. Rev., v. 121: 1702-1703, Mar. 15, 1961.

Isotope shifts in the $4d^9 5s\ ^1D_2 - 4d^9 5p\ ^3F_3^\circ$ transition at λ4212A in the first spectrum of Pd has been studied with the use of enriched isotopes. The shifts are similar to those found by Kuhn and Warner in the $4d^9 5s\ ^3D_3 - 4d^9 5p\ ^3F_4^\circ$ transition at λ3405A. The most interesting feature is the maximum in the isotope shift which appears at the neutron number pair 60-58. (Contractor's abstract)

65

Arkansas U. Dept. of Physics, Fayetteville.

ISOTOPE SHIFTS IN THE SPECTRA OF Mo AND Ru, by R. H. Hughes. [1960] [2]p. incl. diagr. tables. (AFOSR-3550) (AF 49(638)547) Unclassified

Also published in Phys. Rev., v. 121: 499-500, Jan. 15, 1961.

Isotope shifts in several lines showing shifts in the field-effect direction in the spectra of molybdenum and ruthenium have been studied with the aid of a Fabry-Perot interferometer. The variations in the shifts are quite similar in the two elements. A distinct minimum shift between the even-even nuclei occurs at neutron number 56. Extreme even-odd staggering inverts the expected order of the atomic levels belonging to nuclei with neutron numbers 54 and 55. The variations in the shifts were qualitatively predicted by the nuclear deformations as measured by Coulomb excitation, particularly in the case of molybdenum. (Contractor's abstract)

66

Arkansas U. Dept. of Physics, Fayetteville.

MODIFIED WOLLASTON PRISM FOR SPECTRAL POLARIZATION STUDIES, by R. H. Hughes. [1960] [1]p. incl. diagr. (AF 49(638)559) Unclassified

Published in Rev. Scient. Instr., v. 31: 1156, Oct. 1960.

The problem encountered when a Wollaston prism is crossed with a spectrometer in order to make a spectral analysis is resolved. This problem, which is due to the spectrometer treating the different modes of polarization differently whenever a reflecting surface is encountered, is handled by depolarizing the light after passing through the Wollaston so that each image will be treated on an equal basis and a fair comparison made. This is accomplished by having a simple special quartz wedge placed in optical contact with the exit side of the prism. The wedge consists of a piece of crystal quartz cut parallel to the optic axis and oriented with the optic axis at 45°.

Armour Research Foundation, Chicago, Ill. see Illinois Inst. of Tech. Armour Research Foundation, Chicago.

67

Athens U. Dept. of Physics (Greece).

INVESTIGATION OF HEAT VIBRATIONS IN SOLIDS BY USING X-RAYS, by K. D. Alexopoulos. Annual rept. no. 3. Feb. 1, 1959-Jan. 31, 1960 [10]p. incl. diagrs. tables. (AFOSR-TN-60-310) (AF 61(514)1248) Unclassified

This annual report reviews the research conducted under this contract in its third year. Measurements were carried out on tungsten, gold, silver and thallium. The results of the measurements on tungsten are described as erratic due to the exceedingly strong background over which the diffraction lines were barely discernible. It is concluded that tungsten can only be measured with a discriminating counter, perhaps best with a scintillating counter. The experimental results on gold were also erratic. Filtered copper radiation was used and diffraction lines (400, 331, 420, and 422) were measured at 4 different temperatures in the region from room temperature to 472°C. The resulting values were different for the different lines so that the possibility of an anistropy was envisaged. The experiments on silver surrendered no better results on diffraction lines. However experiments with silver precipitate gave good and reproducible results for diffraction line (422). This encouraged research with other diffraction lines which also yielded good results and prompted the investigators to repeat the gold measurements with gold precipitate. Experiments on the high temperature phase of thallium carried out with a rolled sheet did not lead to any results due to strong recrystallization.

68

Atlantic Research Corp., Alexandria, Va.

FURTHER STUDIES OF PURE AMMONIUM PERCHLORATE DEFLAGRATION, by R. Friedman and J. B. Levy. Jan. 28, 1960, 18p. incl. diagrs. tables, refs. (AFOSR-TN-60-209) (AF 18(600)1502) AD 233370; PB 146755 Unclassified

Also published in Eighth Symposium (Internat'l.) on Combustion, California Inst. of Technology, Pasadena (Aug. 28-Sept. 3, 1960), Baltimore, Williams and Wilkins Co., 1962, p. 663-672.

Progress on the effects of pressure, catalyst and added radiant energy on burning rate and the study of the chemistry of the deflagration process and the effect of various parameters on it are described. A deflagration rate-vs-pressure curve showed that pressed pellets of NH_4ClO_4, 4 mm square and 38 mm long, burned at essentially constant pressure in a nitrogen atmosphere. The lower pressure limit was extended from 45 to 22 atm. Experiments showed that the lower limit is insensitive to sample size and to the substitution of He for N as the ambient atmosphere. Small additions of copper chromite powder increased the lower pressure limit while large additions decreased it. A radiant heating apparatus was developed to produce conditions which permit steady deflagration at atmospheric pressure. For pure NH_4ClO_4, there is a critical radiation level (10 cal/sq cm-sec) below which only slow sublimation occurs and above which deflagration occurs. The deflagration rate is essentially linear with radiation flux and extrapolates to a finite rate at zero radiant flux. The addition of Cu-0202 catalyst increased the deflagration rate and reduced the threshold flux required for ignition. The chemical composition of the product gases from deflagrating NH_4ClO_4 were investigated at pressures from atmospheric to 2000 psi, both with and without the copper chromite catalyst. The gaseous products were N, N_2O, and O.

69

Atlantic Research Corp., Alexandria, Va.

THE THERMAL DECOMPOSITION OF 2,2'-AZOISOBUTANE, by J. B. Levy and B. K. W. Copeland. Jan. 1960 [18]p. incl. diagrs. tables, refs. (AFOSR-TN-60-161) (AF 49(638)483) AD 232818; PB 145838 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 5314-5318, Oct. 20, 1960.

The thermal decomposition of gaseous 2, 2'-azoisobutane was studied over the temperature range 180-220°. The principal reaction products were isobutane and nitrogen. Small amounts of methane and 2,2,3,3-tetramethylbutane were also found. A brown solid deposit was invariably formed on the walls. Good first-order kinetics were observed and the temperature dependence of the rate measured. The activation energy of the reaction was found to be 42.8 kcal/mol and the frequency factor 2.2×10^{16} sec-1. In the presence of added nitric oxide, a blue product believed to be 2-methyl-2-nitrosopropane was formed and isobutene and nitrous oxide observed as products. Experiments with added isobutene showed that it was consumed in the reaction. Mirror removal experiments were carried out with antimony mirrors and the lifetime of the t-butyl radical determined. The radical was found to have a substantially longer life than methyl radical. The significance of these results is discussed and a mechanism for the reaction proposed. (Contractor's abstract)

70

Atlantic Research Corp., Alexandria, Va.

TURBULENT FLAME STUDIES IN TWO DIMENSIONAL

OPEN BURNERS, by J. H. Grover and E. N. Fales. Final rept. June 30, 1960 [60]p. incl. illus. diagrs. tables, refs. (AFOSR-TR-60-94) (AF 49(638)510) AD 287793 Unclassified

Investigation verified the concept that the effect of turbulence on flames is only to wrinkle and extend the surface of the flame front. Flash-tube photographs show the instantaneous flame front to be a thin wrinkled continuous boundary between unburned and burned gases. All experimental measurements and the propagation of wrinkles in the high-speed motion picture substantiate this. Results definitely indicate that the ratio of local turbulent flame velocity to the laminar flame velocity, can be correlated with a dimensionless time parameter, and the dimensionless turbulence intensity in the approach flow. A useful technique was developed and verified for determination for a turbulent flame of the mean flow field in the neighborhood of the flame, the mean flame front, the root-mean-square displacement of the mean flame front, the local turbulent flame velocity, and the position of the instantaneous flame front. A technique was developed for following the formation and growth of wrinkles in the instantaneous flame front.

71

Atlantic Research Corp., Alexandria, Va.

SOLID-PROPELLANT SOURCE OF CESIUM PLASMA, by L. W. Fagg and R. Friedman. June 23, 1960, 3p. incl. tables. (AFOSR-TN-60-701) (AF 49-(638)651) AD 230696; PB 153033 Unclassified

An investigation was made of the combustion characteristics and ion and electron density obtainable by burning mixtures of $CsClO_4$:Al and $CsNO_3$:Al. Thermodynamic equilibrium calculations made with an IBM-7704 computer for stoichiometric $CsNO_3$:Al and $CsClO_4$:Al are presented. The calculations give the temperatures and the percentages of the significant ion species for 3 pressures and 2 pressure expansions. It is seen that expansion causes an increase in the equilibrium ion concentration for these conditions. The mixtures were found to be burnable when prepared as strands formed by compression at various forming pressures up to 125,000 pounds per square inch (psi). The $CsNO_3$:Al strands would not burn below about 200 psi, the burning at 300 psi decreasing from 0.2 in./sec at a forming pressure of 3300 psi to 0.12 in./sec at a forming pressure of 125,000 psi. Burning rates increased with increasing pressure, the pressure exponent being well below unity except at the lowest forming pressure. It was found that a weakly tamped stoichiometric mixture of $CsNO_3$:Al powders in a tut would burn at atmospheric pressure.

72

Atlantic Research Corp., Alexandria, Va.

SECOND AFOSR CONTRACTORS' MEETING ON COMBUSTION OF SOLID PROPELLANTS: Abstracts of Papers, Atlantic Research Corp., Alexandria, Va., June 7-8, 1960 [18]p. incl. refs. (AFOSR-TN-60-663) [AF 49(638)813] AD 239150; PB 148876 Unclassified

This report consist of the abstracts of the papers presented at the AFOSR Contractors' meeting on Combustion of Solid Propellants. The mechanism, ignition, combustion, and disturbances in the combustion of solid propellants were among the topics.

73

Atlantic Research Corp., Alexandria, Va.

SOLID PROPELLANT COMBUSTION MECHANISM (Abstract), by R. Friedman and J. B. Levy. [1960] [2]p. (AF 49(638)813) Unclassified

Presented at AFOSR Second Contractors' meeting on Solid Propellant Combustion, Atlantic Research Corp., Alexandria, Va., June 7-8, 1960. (AFOSR-TN-60-663; AD 239150)

The deflagration of pressed strands of pure ammonium perchlorate has been under investigation in an effort to gain a basic understanding of this process and, ultimately, of burning of rocket propellants containing ammonium perchlorate as oxidizer. As a preliminary step in the study, the thermal decomposition of gaseous, anhydrous perchloric acid was investigated. Results showing effect of radiant fluxes of various intensities, to 18 cal/sq cm-sec, on ignition and propagation rate of pure and catalyzed ammonium perchlorate at atmospheric pressure have been obtained. The observation that the product gas temperature was substantially below that expected for thermodynamic equilibrium has led to an investigation of the chemical composition of the products. The nitrogen in the products was found to be distributed among molecular nitrogen, nitric oxide, and nitrous oxide. The nitric oxide fraction decreased from 0.55 at atmospheric pressure to 0.23 at 1000 psi and above. It was unaffected by variation in strand cross-sectional area or by the addition of 3% copper chromite catalyst. The nitrous oxide fraction was constant at 0.1 at pressures up to 1000 psi, dropping to 0.05 at 2000 psi. The addition of the catalyst virtually eliminated nitrous oxide as a product, while increasing the strand cross-sectional area lowered the nitrous oxide fraction.

74

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

THE EXPERIMENTAL DEPENDENCE OF THE COLLISION-FREE SHOCK THICKNESS UPON ALFVEN

MACH NUMBER, by R. M. Patrick. Jan. 1960 [8]p. incl. diagrs. (Rept. no. AMP 38) (AFOSR-TN-60-73) (AF 49(638)61) AD 242269 Unclassified

Also published in Phys. Fluids, v. 3: 321-323, Mar.-Apr. 1960.

Experimental data is presented to support the theoretical suggestion that the thickness of collision shocks is a function of M_A and r_1, where r_1 is the cyclotron radius of an ion moving at the Alfven velocity ahead of the shock and M_A is equal to the ratio of shock velocity to the Alfven velocity. Variation of the Alfven Mach number, M_A, was achieved by changing the magnitude of the plane of the shock front. The overall shock thickness was obtained by multiplying the measured rise time of the radiation signal by the shock speed. When $M_A = 2.0$, the thickness for the shock was 40 mm. When $M_A = 2.6$, the overall thickness was 12mm. The vacuum ultra-violet radiation emitted by the shock-heated plasma was also measured and gave the same results for the shock thickness as the visible radiation. The data indicate a steep dependence of the shock thickness on M_A, the thickness decreasing with increasing values of M_A, and it is concluded that the collisionless shock thickness is a function of M_A and higher values of M_A correspond to thinner collisionless shocks.

75

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

COLLISION-FREE PLASMAS, by H. E. Petschek. Nov. 1960, 12p. incl. diagrs. (Rept. no. AMP 52) (AFOSR-360) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)61 and Office of Naval Research under Nonr-252400) AD 254760; PB 155778 Unclassified

In the corona regions of stars the ratio of the mean free path for interparticle collision to the gyro radius becomes very large. Under these conditions the transport processes in the plasma become dominated by plasma turbulence. This phenomenon can be described in terms of a kinetic theory of a random distribution of waves. The structure of a shock wave under these conditions has been considered. Even at densities as low as 10^2 particles per cm^3 the thickness of such a shock wave should be very thin, less than 100 km. The effects of such a turbulent wave field on reducing the electrical conductivity has also been considered. It seems possible that appreciable diffusion of the magnetic field relative to the plasma could occur under some astronomical conditions. (Contractor's abstract)

76

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

MOLECULAR RADIATION FROM THE RELAXATION ZONE OF SHOCK WAVES (Abstract), by B. Kivel, J. D. Teare, and P. Hammerling. [1960] [1]p. [AF 49(638)61] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 41, Jan. 27, 1960.

The relation between emitted radiation and local translational temperature is considered. At first the radiation depends on an integral from the start of the shock involving the absolute excitation rates. Later, if all of the rates are fast compared to dissociation, a local equilibrium may be established in all aspects except dissociation. Then the density of excited molecular electronic states is uniquely determined by the local properties and is independent of the history of the shock. However, the density for each state depends on the ratio of rates coupling it to the dissociated atoms and to the ground state of the corresponding molecule. The radiating state density is not expected to over-shoot its equilibrium value if both the coupling with atoms is strong and the radiating state has about the same energy as the atoms, since the atom density increases monotonically. An overshoot occurs for a highly excited state coupled to atoms and for radiating state coupled to the ground molecular state because of the overshoot of temperature and of molecular density. The radiation front, in which binary collision processes dominate, has a linear dependence on the initial pressure at constant shock speed.

77

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

PRODUCTION OF SHOCK WAVES IN A COLLISION-FREE PLASMA (Abstract), by R. M. Patrick. [1960] [1]p. [AF 49(638)61] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 316, Apr. 25, 1960.

An experimental investigation of the structure of collision-free magnetohydrodynamic shock waves has been carried out using a magnetic annular shock tube (MAST). The structure has been obtained by measuring the visible and vacuum ultraviolet radiation emitted by the shock heated plasma. The measured shock velocities in hydrogen were between 2×10^7 and 4×10^7 cm/sec. The plasma density behind these shocks was of the order of 10^{16} particles/cm^3. These experimental shock speeds and plasma densities were compared to

theoretical values obtained assuming the plasma in MAST to be perfectly conducting; complete agreement was obtained within the experimental scatter. The variation of the shock thickness with the Alfven Mach number M_A where M_A is equal to the shock velocity divided by the Alfven velocity in the plasma ahead of the shock was measured for $1.5 \leq M_A < 3.2$. A steep dependence of the shock thickness on M_A was found with low values of M_A corresponding to thick shocks and high values of M_A corresponding to thin shocks.

78

[Avco Corp.] Avco-Everett Research Lab., Everett, Mass.

HYDROMAGNETIC EFFECTS ON HEATING AND SHEAR AT A THREE-DIMENSIONAL STAGNATION POINT IN HYPERSONIC FLOW, by N. H. Kemp. [1960] [2]p. incl. diagrs. (AF 49(638)61) Unclassified

Published in Jour. Aero/Space Scl., v. 27: 553-554, July 1960.

A detailed explanation of the results of a three dimensional boundary-layer analysis for a constant property fluid is presented. It is expected that the viscous shear stress is more strongly affected by the magnetic field than the heat transfer rate. It is found that the viscous shear stress parameter ratio is significantly smaller in 3-dimensional than in 2-dimensional flow. The reductions in viscous shear stress and heat-transfer rate is found when the inviscid velocity-gradient ratio is known. Any substantial reduction in both requires large values of the inviscid-flow parameter.

79

Avco Corp [Avco -Everett Research Lab.] Everett, Mass.

MEASUREMENTS OF NONEQUILIBRIUM RADIATION FROM SHOCK WAVES (Abstract), by J. Camm, B. Kivel and others. [1960] [1]p. [AF 49(638)61] Unclassified

Presented at meeting of the Amer. Phys. Soc., Johns Hopkins U., Baltimore, Md., Nov. 21-23, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 212, Mar. 20, 1961.

Measurements have been made of the nonequilibrium radiation from shock waves in air using photoelectric gages, a spectrograph, monochromators, and a bolometer. For these measurements a combustion-driven shock tube 24 in. in diameter was used to produce shocks having speeds of 6.8 mm/μsec in air at an initial pressure of 20μ of Hg. Since the maximum gas temperature is computed to be about 25,000°K before dissociation and vibrational excitation take place, significant amounts of radiation might possibly be found in the spectral region of from 300A to 25μ. The radiant intensity in a direction normal to the shock is about 0.4 w/cm^2 sr, and most of the radiation originates within 5 cm of the shock front.

80

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

HALL EFFECTS IN A LAMINAR BOUNDARY LAYER OF THE HARTMANN TYPE, by J. A. Fay. Dec. 1959, 9p. incl. diagrs. (Research rept. no. 81) (AFOSR-TN-60-291) (AF 49(638)659) AD 236654; PB 147434 Unclassified

The motion in a laminar boundary layer on an infinite flate plate with an applied magnetic field normal to the wall and current flow parallel to the wall is studied for the case of $\omega\tau$(electrical cyclotron frequency times mean free time) not necessarily small. It is found that a cross flow is induced normal to both magnetic field and free stream flow. The net electrical power loss in the boundary layer is determined assuming constant transport properties. (Contractor's abstract)

81

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

SCALING RELATIONS FOR PLASMA DEVICES, by G. S. Janes. Dec. 1959, 11p. incl. table. (Research rept. no. 80) (AFOSR-TN-60-367) (AF 49(638)659) AD 235532 Unclassified

Presented at Fourth Lockheed Symposium on Magnetohydrodynamics, Palo Alto, Calif., Dec. 2, 1959.

Also published in Plasma Acceleration, ed. by S. W. Kash, Stanford Calif., Stanford U. Press, 1960, p. 30-36.

A derivation is given of a set of scaling relations for plasma devices in which the dominant interparticle interactions occur as a result of coulomb collisions. These scaling relations have application in the avoidance of redundant experimentation and in the design of laboratory scale experiments to simulate the principal conditions of interest to an engineering objective. (Contractor's abstract)

82

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

ANALYSIS OF CONSTANT VELOCITY PULSED PLASMA ACCELERATOR, by Z. J. J. Stekly. July 1960, 19p. incl. diagrs. (Research rept. no. 89) (AFOSR-TN-60-935) (AF 49(638)659) AD 243359 Unclassified

The equations are set down in a dimensionless form for a constant velocity pulsed plasma accelerator,

treating the accelerator as a circuit element. The equations are solved in closed form and plots of voltage, current, gas energy and required mass distribution are obtained. It is shown that circuit inductance both reduces and delays the energy transfer from the capacitors to the gas. A typical design for a constant velocity pulsed plasma accelerator is obtained making use of the dimensionless plots obtained as a result of the analysis. (Contractor's abstract)

83

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

MAGNETOHYDRODYNAMIC PROPULSION, by G. S. Janes. Aug. 1960, 68p. incl. illus. diagrs. table. (Research rept. no. 90) (AFOSR-TN-60-955) (AF 49(638)-659) AD 243117 Unclassified

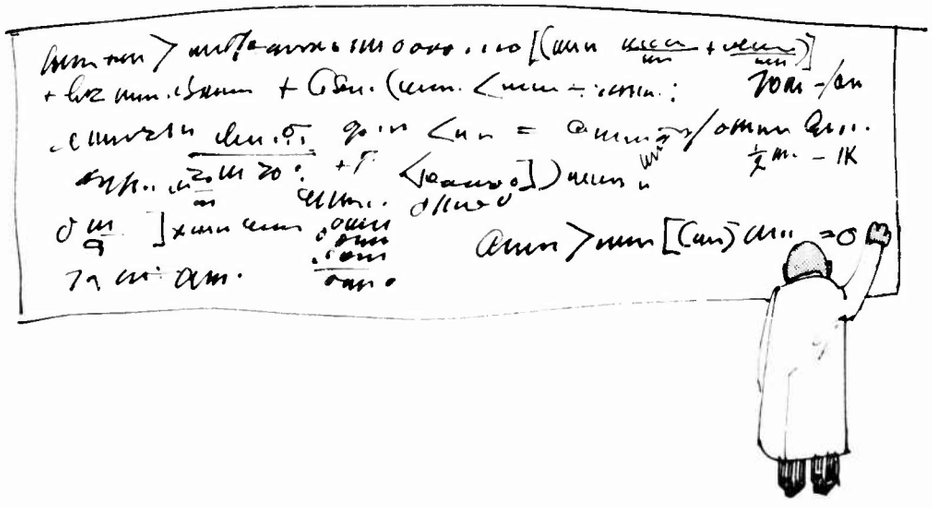
The morphology of plasma propulsion devices is presented following a brief discussion of the requirements for mission objectives. The two criteria employed for this classification are field-current configurations and containment. Containment is essential for efficiency and probably represents the primary area requiring further research. Both aerodynamic and magnetic containment are considered. The various categories of electrical motors are completely analogous to the categories of field-current configurations. Three specific examples of devices being studied at AERL are presented together with a qualitative discussion of the basic physical principles necessary for their understanding. (Contractor's abstract)

84

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

RESEARCH ON PLASMA PROPULSION. Summary rept. Dec. 1959. 49p. incl. illus. diagrs. refs. (AFOSR-TR-60-49) (AF 49(638)659) Unclassified

Several aspects of the research dealing with plasma propulsion are briefly reviewed. The first six months of this task have been devoted to (1) outlining the requirements for efficient propulsion systems, (2) analytically investigating the characteristics of the different categories of plasma thrust devices, and (3) initiating experimental programs for studying the properties of what currently appear to be the two most attractive types of plasma thrust devices. The first of these is reported on in another report (item no. 58, Vol. III). It was decided that the alkali metals and, in particular, lithium and sodium were very attractive as propellant choices. A detailed discussion of the characteristics of a device with viscous containment and direct current shunt coupling betweenthe magnetic field and the plasma is given. It is pointed out that boundary layer and magnetic field losses dominate this design. A pulsed magnetically contained plasma accelerator is also discussed. The efficiency of this class of devices increases with increasing specific impulse. Research has also been done on a continuously operating magnetically contained electrodeless traveling wave accelerator. It, like the pulsed magnetically contained plasma accelerator, also has a minimum size limitation connected with the containment requirement, but a much less restrictive minimum power limitation. This device, reportedly, is very attractive and research programs are being continued in this area in the hopes of obtaining both containment and inductive coupling in a hitherto largely unexplored domain of plasma physics.



Bartol Research Foundation, Swarthmore, Pa.
See Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

85

Battelle Memorial Inst., Columbus, Ohio.

INFLUENCE OF CONDUCTIVITY GRADIENTS ON GALVANOMAGNETIC EFFECTS IN SEMICONDUCTORS, by R. T. Bate and A. C. Beer. Oct. 15, 1960 [19]p. incl. diagrs. refs. (Technical note no. 3) (AFOSR-TN-60-1225) (AF 49(638)222) AD 245305 Unclassified

Also published in Jour. Appl. Phys., v. 32: 800-805, May 1961.

An approximate solution is found of a boundary-value problem arising from the continuity equation in an inhomogeneous semiconductor, leading to rotational current vectors. Results are used to predict the effect of carrier-concentration gradients on magnetoresistance. The predicted weak-field effects are especially significant in degenerate semiconductors and n-type III-V intermetallics where the "intrinsic" magnetoresistance is small. In strong fields, even small gradients in carrier concentration can completely alter the field dependence of the magnetoresistance. Experimental results indicate that transverse currents, which do not occur in the simple case discussed, do appear in general, and further perturb the magnetoresistance. The influence of inhomogeneous magnetic fields is discussed briefly. (Contractor's abstract)

86

Battelle Memorial Inst., Columbus, Ohio.

INFLUENCE OF MAGNETOCONDUCTIVITY DISCONTINUITIES ON GALVANOMAGNETIC EFFECTS IN INDIUM ANTIMONIDE, by R. T. Bate, J. C. Bell, and A. C. Beer. Oct. 16, 1960 [29]p. incl. diagrs. refs. (Technical note no. 4) (AFOSR TN-60-1226) (AF 49-(638)222) AD 246424; PB 153199 Unclassified

Also published in Jour. Appl. Phys., v. 32: 806-814, May 1961.

Anomalous galvanomagnetic effects associated with spatial discontinuities in carrier concentration were observed in n-type InSb. These discontinuities resulted from anisotropic segregation of impurities during crystal growth. An increase in the magnitude of the Hall coefficient at 20,000 gauss to nearly twice the weak-field value was observed in one case. The magnetoresistance is especially sensitive to inhomogeneities. For an inhomogeneous sample at a particular magnetic field, the measured $\Delta\rho/\rho_0$ might be as much as 100 times larger than that for a homogeneous sample. Negative magnetoresistance was also observed at room temperature in inhomogeneous samples. All of the above observations were predicted qualitatively by considering a simple model consisting of a long, thin specimen having a discontinuity in resistivity and Hall coefficient in the current direction. The boundary value problem corresponding to this case is solved to predict the electric field and current densities. (Contractor's abstract)

87

Battelle Memorial Inst., Columbus, Ohio.

BASIC TRANSPORT PHENOMENA IN GERMANIUM AND INDIUM ANTIMONIDE, by R. T. Bate, S. E. Miller, and A. C. Beer. Final rept. Oct. 31, 1960 [12]p. incl. refs. (AFOSR-TR-60-158) (AF 49(638)222) AD 246156; PB 171511 Unclassified

The growth of InSb single crystals as well as the transport properties of InSb and semiconducting diamond were studied. Summaries are given of progress made in: (A) galvanomagnetic effects in InSb; (B) purification and single crystal growth; (C) galvanomagnetic effects in semiconducting diamond; and (D) inhomogeneities and associated galvanomagnetic effects in semiconductors. The obtained results indicate that inhomogeneity is probably the key to reconciliation of theory and experiment in the study of strong-field magnetoresistance in many semiconductors. This should eventually lead to the determination of the true influence of quantum effects on magnetoresistance. Furthermore, it is pointed out that these studies are very important in the design of galvanomagnetic devices.

88

Battelle Memorial Inst., Columbus, Ohio.

ANISOTROPIC SEGREGATION IN InSb, by W. P. Allred and R. T. Bate. [1960] [4]p. incl. illus. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)222] and WADD Electronics Components Laboratory) Unclassified

Presented at 117th meeting of the Electrochem. Soc., Chicago, Ill., May 1-5, 1960.

Abstract published in Jour. Electrochem. Soc., v. 107: 64C, Mar. 1960.

Also published in Jour. Electrochem. Soc., v. 108: 258-261, Mar. 1961.

The anisotropic segregation of Se in InSb was studied by utilizing Se^{75} as a tracer element. A core consisting of a high concentration of Se was found in the center of crystals pulled in the [111] direction. This phenomenon is thought to result from an extremely rapid lateral growth occurring on the (111) facet. Well-defined striations were also observed. Crystals grown from seeds oriented in directions other than the [111] were found to have high concentrations of Se in the (111) facets near the edge of the crystal, thus removal of the edges left

the major portion of the crystal relatively homogeneous and with lower impurity content. A description is given of the probable growth mechanism of an InSb crystal. (Contractor's abstract, modified)

89

Battelle Memorial Inst., Columbus, Ohio.

EFFECT OF INHOMOGENEITIES ON THE HALL COEFFICIENT IN InSb (Abstract), by R. T. Bate. [1960] [1]p. [AF 49(638)222] Unclassified

Presented at 117th meeting of the Electrochem. Soc., Chicago, Ill., May 1-5, 1960.

Abstract published in Jour. Electrochem. Soc., v. 107: 65C, Mar. 1960.

Crystals of n-type InSb have been grown which were doped with Se and pulled in such a way that the Se segregated during growth to produce large impurity gradients. These impurity gradients were mapped and their effect on the galvanomagnetic coefficients determined. Results indicated very pronounced effects, such as an increase of the Hall coefficients at room temperature by nearly a factor of two, as the magnetic field is increased from 1,000 to 20,000 gauss.

90

Battelle Memorial Inst., Columbus, Ohio.

INFLUENCE OF INHOMOGENEITIES ON THE GALVANOMAGNETIC EFFECTS IN n-TYPE InSb (Abstract), by R. T. Bate, R. K. Willardson, and A. C. Beer. [1960] [1]p. [AF 49(638)222] Unclassified

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 152, Mar. 21, 1960.

When single crystals of high purity InSb are grown in the <111> direction, anisotropic segregation of residual donor impurities occurs. This segregation can produce longitudinal and radial gradients in the extrinsic electron concentration in the crystal. Changes of an order of magnitude in carrier concentration from the center axis to the surface of a crystal have been observed. If a sample is cut from an inhomogeneous region in the crystal and current is directed through it in the presence of a strong transverse magnetic field, the carrier gradient may superimpose circulating currents on the drift current. These currents markedly influence the observed galvanomagnetic effects in the extrinsic temperature range. For example, the absolute value of the Hall coefficient was observed to increase approx as logH in the strong field region, and to be as much as twice as large at 20 kgauss as its weak field value. The magnetoresistance is especially sensitive to inhomogeneities. For an inhomogeneous sample at a particular magnetic field, $\Delta\rho/\rho_0$ may be as much as 100 times larger than that for a homogeneous sample. Negative magnetoresistance has also been observed at room temperature in inhomogeneous samples.

91

Battelle Memorial Inst., Columbus, Ohio.

GALVANOMAGNETIC EFFECTS IN SEMICONDUCTORS CONTAINING IMPURITY GRADIENTS, by R. T. Bate and A. C. Beer. [1960] [5]p. incl. diagrs. [AF 49(638)-222] Unclassified

Published in Proc. Internat'l. Conf. on Semiconductor Physics, Prague (Czechoslovakia) (Aug. 29-Sept. 2, 1960), Prague, Publishing House of the Czechoslovak Academy of Sciences, 1961, p. 177-181.

An approximate solution of a boundary value problem arising from the continuity equation in an inhomogeneous semiconductor is obtained. The results are used to predict the effect of a carrier gradient on magnetoresistance. The predicted weak-field effects are significant in degenerate semiconductors and n-type III-V intermetallics. In strong fields, even small gradients in carrier concentration can completely alter the field dependence of the magnetoresistance. Experimental results indicate that transverse currents, which do not occur in the simple case discussed, do appear in general and further perturb the magnetoresistance. (Contractor's abstract)

92

Battelle Memorial Inst., Columbus, Ohio.

EFFECT OF HIGH PRESSURE ON ELECTRICAL PROPERTIES OF NiO, CoO, CuO, AND Cu_2O, by A. P. Young, W. B. Wilson, and C. M. Schwartz. Sept. 1, 1960, 23p. incl. diagrs. table, refs. (Technical note no. 1) (AFOSR-TN-60-629) (AF 49(638)441) AD 241880 Unclassified

Also published in Phys. Rev., v. 121: 77-82, Jan. 1, 1961.

The effect of pressure on electrical resistance and Seebeck coefficient at or near room temperature in NiO, CoO, CuO, and Cu_2O has been determined. Equations relating the Seebeck coefficient to hole concentration have been used to calculate the effect of pressure on hole mobility. In all materials examined, hole mobility was decreased by pressures to 60,000 atm. It has been proposed that NiO charge transport occurs by the motion of holes trapped at local sites by polarization of the surrounding lattice. The effect of pressure on the diffusion of self-trapped holes has been considered. Motion of self-trapped holes in an ionic crystal and of

vacancies in a metal may be similar to the extent that the motion of either probably involves cooperative movements of surrounding ions or atoms. Some inward relaxation probably occurs around either a hole trapped at a local site in an ionic crystal or around a vacancy in a metal. In either case pressure would be expected to decrease the jump frequency for motion of the defect. It is proposed that in NiC, CoO, and CuO, the decreased hole mobility with pressure was due to a decrease in diffusion rate of self-trapped holes. The explanation for pressure effects in Cu_2O may be more complicated since Cu_2O is generally regarded as a wide band semiconductor. (Contractor's abstract)

93

Battelle Memorial Inst., Columbus, Ohio.

MEASUREMENT OF PRESSURE EFFECT ON THE SEEBECK COEFFICIENT OF POWDER COMPACTS, by A. P. Young, P. B. Robbins and others. [1959] [2]p. incl. diagrs. (AFOSR-3590) (AF 49(638)441) Unclassified

Also published in Rev. Scient. Instr., v. 31: 70-71, Jan. 1960.

A method has been devised for measuring the effect of pressure on the Seebeck coefficient in an apparatus known as the "simple squeezer." Measurements were taken on samples with a resistence range of 50 to 50,000 ohms. At pressures up to 20,000 atmos, the sample resistance, and in some materials the thermoelectric voltage, are dependent in part on degree of compaction. At higher pressures there may still be some irreversible effects on resistivity and thermoelectric voltage probably due to nonhydrostatic stresses on the sample.

94

Battelle Memorial Inst., Columbus, Ohio.

SEMICONDUCTOR ABSTRACTS: ABSTRACTS OF LITERATURE ON SEMICONDUCTING AND LUMINESCENT MATERIALS AND THEIR APPLICATIONS. VOLUME VI - 1958 Issue, ed. by J. J. Bulloff and C. S. Peet. New York, John Wiley and Sons, Inc., 1961. (AFOSR-TR-60-167) (AF 49(638)495) Unclassified

A total of 1933 abstracts are in this volume. They are compiled under the following general headings: (1) Elemental semiconductors (germanium and silicon with respect to band structure, lattice properties, carriers, impurities, surfaces, recombination, optical effects, and other effects); (2) other elemental semiconductors (carbon, selenium and tellurium); (3) halides (lithium fluoride, sodium chloride, potassium chloride, other alkali halides, silver halides, and other halides); (4) oxysalts; (5) oxides; (6) chalcogenides (zinc sulfide, cadmium sulfide, other divalent-metal chalcogenides, lead chalcogenides, bismuth telluride, and other polyvalent-metal chalcogenides); group III-V intermetallics (indium antimonide, indium arsenide, gallium arsenide, aluminum antimonide, and other III-V semiconductors); (7) other inorganics; (8) organics; and (9) theory pertaining to general, defects and dislocations, impurities, excitons, phonons and polarons, carriers, Hall phenomena, galvanomagnetic effects, magnetoresistances, hot carriers, recombinations, surface and related effects, luminescence F-centers, color centers, electroluminescence, photoelectromagnetism photoemissions, thermoelectricity, chemisorption, and other effects; (10) applications pertaining to semiconductors (crystal growth, purification, preparation, doping, and surface treatments), junctions (preparation and properties), and rectifiers (preparation, and properties), diodes, transistors, luminous materials, and miscellaneous applications. Author and subject indices are also included.

95

Battelle Memorial Inst., Columbus, Ohio.

SEMICONDUCTOR ABSTRACTS: ABSTRACTS OF LITERATURE ON SEMICONDUCTING AND LUMINESCENT MATERIALS AND THEIR APPLICATIONS, Volume VII - 1959 Issue, ed. by J. J. Bulloff and C. S. Peet. New York, John Wiley and Sons, Inc., 1962. (AFOSR-814) (AF 49(638)495) AD 458157 Unclassified

This is the last volume published in this series. It consists of a total of 3127 abstracts and is compiled under the following general headings: (1) General (surveys and reviews, and theory of semiconductors); (2) elemental semiconductors (germanium, silicon, and other elements as selenium, tellurium, diamond, graphite, carbon, boron, etc.); (3) compound semiconductors (potassium chloride, sodium chloride, silver halides, other halides, oxysalts, oxides, zinc sulfide, cadmium sulfide, other chalcogenides, intermetallic III-V compounds, other inorganic compounds, and organic compounds); and (5) applications. Author and subject indices are also included.

96

[Baylor U. Coll. of Medicine, Houston, Tex.]

AUTOMATIC ANALYSIS OF THE ELECTROENCEPHALOGRAM: A REVIEW AND CLASSIFICATION OF SYSTEMS, by N. R. Burch. [1959] [8]p. incl. refs. (AFOSR-TN-60-70) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)79] and [WADC] Aero Medical Laboratories) AD 231220 Unclassified

Published in Electroencephalog. and Clin. Neurophysiol. Jour., v. 11: 827-834, Nov. 1959.

Neurophysiological coding remains inadequately understood and no appropriate mathematical criteria have been established to predict the optimum operation for automatic analysis. However, certain constraints are

set on any system of analysis by the EEG as an amplitude-time distribution. The questions that may be asked of the EEG function must be asked about a fixed time interval and answered as amplitude variables or asked about fixed amplitude relationships and answered as variables in time. All attempts at automatic analysis of the EEG seem to logically fall in 1 or 2 classes; all systems may be understood as operating principally in either the time domain of fixed amplitude relations or in the frequency domain of variable amplitude relations, but almost always at the cost of information not completely resolved in the other domain. A review of most known systems of analysis is undertaken with all cases in the frequency domain divided into: (1) high resolution data processing and (2) continuous data processing techniques. Time domain analysis is reviewed with the system classified as (1) interval point coding; (2) peak point coding; (3) selected amplitude coding; and (4) baseline cross coding. Period analysis is described as a final system in time domain analysis which emphasizes wave shape factors by the use of baseline cross points in the primary EEG (major period) and baseline cross points of the second derivative (minor period) to characterize the superimposed low voltage activity.

97

[Baylor U. Coll. of Medicine, Houston, Tex.]

A BIOELECTRIC SCALE OF HUMAN ALERTNESS: CONCURRENT RECORDINGS OF THE EEG AND GSR, by N. R. Burch and T. H. Greiner. [1960] [11]p. incl. diagrs. refs. (AFOSR-TN-60-378) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)79] and WADC Aero Medical Laboratories) AD 234815 Unclassified

Presented in part to the Advisory Group for Aeronautical Research and Development, N.A.T.O., Oslo (Norway), May 1956.

Published in Psychiat. Research Repts. 12: 183-193, Jan. 1960.

A bioelectric scale of human alertness is derived for EEG major and minor period count as related to concurrent GSR amplitudes and count. While period counts of EEG are obtained automatically, and can be equated directly to dominant and superimposed frequency, the interpretation of GSR as a measure of alertness depends upon distinguishing between GSRs to specific stimuli and those of non-specific origin. GSR response to specific stimuli is considered a measure of performance reflecting alertness. Both non-specific GSR count and left P-O EEG minor period count show a monotonic increase with arousal, and appear to reflect the same aspect of neurophysiologic status. Both EEG major period count and specific GSR amplitude follow a bell-shaped curve except for the paradoxical spike (in the period of light sleep) that has confused GSR interpretation so much in the past. (Contractor's abstract)

98

Baylor U. Coll. of Medicine, Houston, Tex.

NEUROENDOCRINE RELATIONSHIPS, by C. Fortier and J. de Groot. [1959] [14]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)384 and National Institutes of Health) Unclassified

Published in Progr. in Neurol. and Psychiat., v. 14: 256-269, 1959.

A shift of interest from the hypothalamus proper to the telencephalic and mesencephalic systems which impinge upon this complex area, and possibly modulate its regulatory influence on endocrine functions, of these, the limbic system and reticular formation have received particular attention. The involvement of neurohypophysial principles in the regulation of adenohypophysial activity underlines the possible significance of the "neural lobe portal vessels" and of the vascular connections between neurohypophysis and adenohypophysis observed at the distal pole of the infundibular process as well as in the median eminence. The neuroendocrine relationships of (1) corticotrophin, (2)thyrotrophin, (3) gonadotrophins and reproduction, (4) somatotrophin, and (5) aldosterone are reviewed.

99

Baylor U. Coll. of Medicine, Houston, Tex.

ORGANIC BINDING OF RADIOIODINE BY INCUBATED THYROID SEGMENTS FROM THE THYROXINE-PRETREATED GUINEA PIG. A BASIS FOR A NEW THYROTROPIN ASSAY (Abstract), by C. Fortier and W. F. Schindler. [1960] [2]p. (AFOSR-TN-60-75) (AF 49(638)384) AD 241473 Unclassified

Presented at the First Internat'l. Cong. of Endocrinology, Copenhagen (Denmark), July 18-23, 1960.

Published in Abstracts of Communications, Copenhagen, 1960, p. 1099-1100.

The responsitivity of thyroid tissue to thyrotropin (TSH) under in vitro conditions has been reported by several groups. The choice of a parameter of thyroid function suitable to TSH assay is studied. Sixty-four segments from a single guinea pig thyroid were uniformly distributed into 8 lots and incubated in a Dubnoff Shaker-Incubator at 38°C in Krebs-Ringer-Bicarbonate medium (pH 7.4, in an atmosphere of 95% O_2 + 5% CO_2) containing 2 μc of carrier-free I^{131}/1.5 ml, with or without added TSH (U.S.P. Reference Standard Thyrotropin). Preliminary studies revealed that both uptake and organic binding of I^{131} (as determined by precipitation with trichloroacetic acid (TCA) by the incubated segments responded quantitatively to TSH at all time intervals (15-120 min). The PBI^{131}/tissue wt ratio provided a composite indicator of the 2 effects and was more sensitive

than either. Radiochromatography (n-butanol-acetic acid-water, descending) of nonhydrolyzed saline extracts of incubated tissues confirmed the results of TCA precipitation with respect to distribution or organic and inorganic I^{131}, and effect of TSH on protein binding. Monoiodothyrosine (MIT) and diiodothyrosine (DIT) were the only iodinated amino-acids detected in pancreatin hydrolysates, and respectively accounted for 50 and 10% of the total radioactivity of the 15-min non-stimulated samples. TSH was found to accelerate the iodination of MIT into DIT. In order to assess the effect of prior blockade of the endogenous secretion of TSH on the in vitro response of the thyroid, glands were collected for incubation from donors pretreated with DL-thyroxine (0.05 mg in 2 daily s.c. injections) for various periods. Within 8 days of treatment, basal in vitro uptake and protein binding of I^{131} were depressed to about 50% of the normal. Responsitivity to TSH in terms of PBI^{131} formation/mg of tissue evidenced a two-threefold increase after 2 days of thyroxine administration and slowly declined thereafter. An optical effect was recorded with 15 min of incubation with TSH of glands obtained from 2-day pretreated donors. These conditions were adopted in later experiments aimed at determining the log dose-response slope of the system over a range of 0.25 to 65 U.S.P. mu of TSH/10 mg of tissue, at a logarithmic interval of 0.3979. A linear relationship between log dose and response was observed between 0.5 and 20 $m\mu$. Pending satisfactory outcome of specificity tests still to be carried out, the results would appear to provide the basis for a simple, accurate and sensitive assay for TSH. (Contractor's abstract)

100

Baylor U. Coll. of Medicine, Houston, Tex.

EFFECT OF THYROXINE PRETREATMENT ON UPTAKE AND ORGANIC BINDING OF I^{131} BY INCUBATED GUINEA PIG THYROID SEGMENTS (Abstract), by C. Fortier and W. J. Schindler. [1960] [1]p. (AFOSR-TN-60-76) (AF 49(638)384) Unclassified

Presented at 44th annual meeting of the Fed. Amer. Soc. for Exper. Biol., Chicago, Ill., Apr. 11-15, 1960.

Published in Fed. Proc., v. 19 (Pt. I): 171, Mar. 1960.

Incubation of guinea pig thyroid segments in a medium containing I^{131} revealed that both uptake and organic binding of I^{131} (as determined by TCA precipitation) responded quantitatively to TSH. The PBI^{131}/tissue-weight ratio provided a composite indicator of the 2 effects, more sensitive to either. Radiochromatography of non-hydrolyzed tissue extracts confirmed results of TCA precipitation with respect to distribution of organic and inorganic I^{131}, and effect of TSH on protein binding. MIT and DIT, the only iodinated amino-acids detected in pancreatin hydrolysates, respectively accounted for 50 and 10% of the total radioactivity of non-stimulated samples. TSH was found to accelerate iodination of MIT into DIT. To assess effect of prior blockade of endogenous TSH secretion, glands were collected from donors pretreated with DL-thyroxine. Within 8 days of treatment, basal in vitro uptake and protein binding of I^{131} were depressed to 50% of normal. Responsitivity to TSH evidenced a 2-threefold increase after 2 days, and slowly declined thereafter. These results, supplemented by evidence of a linear log dose-response relationship over a wide range, provide the basis for a simple and accurate TSH assay. (Contractor's abstract)

101

Baylor U. Coll. of Medicine, Houston, Tex.

AUTOMATIC SCANNING OF PAPER STRIP CHROMATOGRAMS OF I^{131}-LABELED COMPOUNDS, by W. J. Schindler and C. Fortier. [1960] [4]p. incl. illus. diagrs. (AFOSR-TN-60-1149) (AF 49(638)384) AD 260908 Unclassified

Also published in Canad. Jour. Biochem. and Physiol., v. 39: 629-632, Mar. 1961.

The dual scintillation detector-strip recording assembly for β and γ radiations is described schematically. Excellent sensitivity and resolution are achieved by means of two Pb-shielded, narrow CsI(Tl-activated) scintillation crystals facing each other and coupled to phototubes. The narrow width (3 mm) of the crystals allows adequate resolution without recourse to collimation and consequent loss of sensitivity, which can be further enhanced by using crystals (0.4-0.5 mm apart) on both sides of the strip, and in close contact with the latter. Good correspondence was observed between the zones of activity evidenced by radioautography and the peaks of the scanning records.

102

Baylor U. Coll. of Medicine, Houston, Tex.

[A SIMPLE, SPECIFIC AND ACCURATE ASSAY OF TSH] by C. Fortier and W. J. Schindler. [Final rept.] Apr. 15, 1959-Aug. 31, 1960. Sept. 9, 1960 [34]p. incl. illus. diagrs. tables. (AFOSR-TR-60-138) (AF 49(638)384) Unclassified

The search for a metameter of thyroid function suitable for TSH assay was carried out in the following 4 phases: (A) An automatic scanning apparatus was developed; (B) the in-vivo biogenesis of the thyroid hormone was studied in the guinea pig by means of electrophoretic, radioautographic and chromatographic procedures; (C) the in-vitro release of tracer from glands obtained from donors, pretreated in-vivo with I^{131} and showing maximal uptake and protein binding, was assessed as a possible assay metameter for TSH; and (D) it was

concluded that organic binding of I^{131} by incubated thyroid segments from the thyroxine-pretreated guinea pig provides the basis for a simple, specific and accurate assay for TSH. The results obtained of each phase are outlined with illustration.

103

Bell Aerospace Corp. Bell Aerosystems Co., Buffalo, N. Y.

OBSERVATION OF PROPELLANTS INJECTED INTO A FIRING ROCKET CHAMBER, by T. C. Rossmann. July 1, 1960 [57]p. incl. illus. diagr. refs. (Rept. no. 8007-981-011) (AFOSR-TR-60-98) (AF 49(638)260) AD 243514 Unclassified

Various liquids were injected into a firing windowed rocket chamber, in order to check, if necessary, to supplement existing theories dealing with evaporation rates of droplets, as to their applicability to conditions existing in rocket combustion chambers. The resulting droplets were photographed by means of an experimental technique especially developed for this purpose, which provides a succession of magnified shadow pictures of the liquid core of the droplets traveling in the combustion gases. The present report describes (a) experiments with liquids heated before injection in an attempt to obtain measurable evaporation rates of droplets larger than 100 microns. It was found that, essentially, 100 micron drops of water preheated up to 380°F before entering the injector approach the exhaust nozzle without noticeable change in size. At higher preheat temperatures, the injection is every erratic. (b) The windowed motor technique was utilized for investigations concerning the effect exercised on the injection pattern by disturbances introduced into the feed system. It was found that a single, steep pressure pulse results in the sudden formation of a cloud of fine mist in a short distance downstream of the injector orifice, likely to cause transient and local highly increased rates of evaporation and combustion. Ways and means to overcome these difficulties are suggested. (Contractor's abstract, modified)

104

[Bell Aerospace Corp.] Bell Aerosystems Co., Buffalo, N. Y.

A NEW APPROACH TO SAFE FLIGHT FLUTTER TESTING, by M. B. Zisfein and B. B. D'Ewart [Jr.]. Sept. 1960 [29]p. (Rept. no. 9015-19-002) (AFOSR-TN-60-1027) (AF 49(638)749) AD 292018; PB 152687 Unclassified

Presented at the Soc. Exper. Test Pilots Symposium, Oct. 6-8, 1960.

Also published in Soc. Exper. Test Pilots, Quart. Rev., v. 5: 296-320, Winter 1960.

The synthesis, analysis, and experimental evaluation of a new method of flight flutter testing were studied. The method is based on the well-known fact that small changes in mass distribution can drastically change the vibrational properties of an oscillating aerodynamic surface, and can bring about substantial changes in its flutter speed. This method employs a jet device to simulate the force effects of mass and to create thereby an apparent change in the mass distribution of an aerodynamic surface. This apparent mass change can be easily manipulated to make flutter come or go, and can therefore be used as a safe, fail safe, positive, flight flutter test device. This report presents a very brief historical background, a discussion of the basic principles of "jet mass" and its effect on flutter, and a description of the design details of 2 jet mass prototypes and a wind tunnel flutter model. Subsequent sections describe the laboratory and wind tunnel tests on the prototype jet mass systems. It is concluded by giving recommendations for the development of the future jet mass system. (Contractor's abstract, modified)

105

Bell Aerospace Corp. Bell Aerosystems Co., Buffalo, N. Y.

DETAILS OF A NEW APPROACH TO SAFE FLIGHT FLUTTER TESTING, by B. B. D'Ewart, Jr. and R. F. Farrell. Nov. 1960 [112]p. (Rept. no. 7-60-9180002) (AFOSR-TN-60-1476) (AF 49(638)749) AD 249804; PB 154222 Unclassified

A basic research program concerned with the synthesis, analysis, and experimental evaluation of a new method of flight flutter testing is described. The method is based on the well known fact that changes in mass distribution can drastically change the vibrational properties of an oscillating aerodynamic surface, and can bring about substantial changes in its flutter speed. A jet device is employed to simulate the force effects of mass and to create thereby an apparent change in the mass distribution of an aerodynamic surface. This apparent mass change can be easily manipulated to make flutter come or go, and can therefore be used as a safe, reliable, flight flutter test device. Equipment and tests are described that utilize mass simulation and develop an analytical method for studying the important features of a nonlinear mass simulating system. Mass simulation was shown to have great promise as a device for improving the safety and speed of flight flutter test programs. (Contractor's abstract)

106

Bell Aerospace Corp. Bell Aerosystems Co., Buffalo, N. Y.

APPROXIMATION METHODS FOR AEROELASTIC SYSTEMS IN HIGH SUPERSONIC FLOW, by M. B. Zisfein and F. J. Frueh. Summary rept. Oct. 1960 [100]p. incl.

illus. diagrs. table. (Rept. no. 7019-918001) (AFOSR-TR-60-182) (AF 49(638)749) AD 249805; PB 154221 Unclassified

A description is presented of a new dynamic system logic. This new approach to aeroelastic system dynamics is shown not to contradict the currently established fact, but rather to be useful in the derivation of new and relatively simple dynamic system approximations. Previously published binary aeroelastic system solutions are summarized as a basis for the physical understanding of the fundamental phenomenon of modal coalescence. The new concepts of V- OMEGA Base curve, High Damping Asymptote, and High Decay Asymptote are reviewed and discussed. The use of these concepts in the formulation of aeroelastic system approximations is introduced. The concepts previously developed in the binary systems study are employed to formulate certain relatively simple approximations to predict the damping and decay properties of ternary aeroelastic systems. New and more sophisticated approximations are developed to relate true system dynamic response to artificial flutter damping in a manner independent of system basic parameters. This is done by using the logic developed for binary systems and the results of both the binary and ternary solutions previously developed. These new approximations are found to be valid for all of the binary and ternary systems studied to date. They allow the analyst to predict an aeroelastic system's true dynamic response from merely the results of a simple harmonic motion, required structural damping analysis commonly known as an AMC type flutter solution. (Contractor's abstract)

107

Bell Aircraft Corp., Buffalo, N. Y.

AEROPHYSICS OF RECOVERABLE TEST VEHICLES, by B. B. D'Ewart, Jr. and M. B. Zisfein. [1960] 29p. incl. illus. diagrs. (Status rept. no. 5) (AFOSR-TR-60-15) (AF 49(638)380) Unclassified

The work done on the development and demonstration of the jet mass concept between July 1 and Oct. 19, 1959 is described. A wing tip manifold was designed and manufactured to carry the air supply from the wing main beam air tube to the trailing edge of the wing at the tip station. It was tested and found satisfactory. The jet mass mechanism was furnished with a slide wire transducer to measure vane angle of attack, and an electrical system for vane phase angle control. The latter system allowed the model damping rate to be arbitrarily set at high positive or negative values or at any point between by setting amplifier gain and output polarity. A new nozzle was also designed and manufactured. It used 1/2 the mass flow of the original nozzle and will produce adequate negative mass for wing tunnel testing.

108

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[FINAL REPORT ON COMPARATIVE NEUROANATOMICAL STUDY] by E. Grünthal. Technical final rept. no. 12, Oct. 1-Dec. 31, 1960 [3]p. incl. refs. (AFOSR-287) (AF 61(052)3) AD 253745 Unclassified

A study was made of the anatomy of the beaver brain and of related rodents from the viewpoint of relating functional anatomy to neurophysiological and behavioral observations. The microscopic studies of the following were continued: (1) the limbic system, i.e. cingulum, septal region, hippocampus, amygdala; etc., and (2) bulbus olfactorius and lobus pyriformis. Comparative studies were continued of the histology as well as the gross anatomy of the brain of other highly developed rodents. The preparation of stereotactic guides for neurophysiological experimentation was initiated. Studies of behavior in wild conditions and/or in captivity using motion pictures and/or tape recording were continued. (Contractor's abstract)

109

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[ANATOMY OF THE HYPOTHALAMUS OF THE BEAVER IN RELATION TO MORPHOLOGICAL ASPECTS OF NEUROSECRETION] Die Anatomie des Hypothalamus des Bibers (Castor canadensis) nebst morphologischen Aspekten der Neurosekretion, by G. Pilleri. [1959] [10]p. incl. illus. diagr. tables. [AF 61-(052)30] Unclassified

Published in Acta Anat., v. 38: 126-135, 1959.

The hypothalamus and hypophysis of the beaver were studied macroscopically. Noteworthy are the extensive pars oralis tuberis and the horizontal position of the hypophysis which comes in contact with the pontine margin. Staining the diencephalon with chrome-alum-phloxine by the Gomori method gives a positive reaction in the supraoptic nucleus. Azons in the region were stained blue. The paraventricular nucleus and the region of the tuber have a negative reaction. No neurosecretion can be demonstrated by the Gomori method in the infundibulum, whereas there is abundant secretory substance in the neurohypophysis. (Contractor's abstract)

110

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[THE BRAIN OF THE CANADIAN BEAVER. FIRST COMPREHENSIVE RESULTS FROM MACROSCOPIC INVESTIGATIONS] Das Gehirn des kanadischen Bibers. Erste zusammenfassende Ergebnisse nach makroskopischen Untersuchungen, by G. Pilleri. [1959] [9]p. incl. illus. diagrs. tables, refs. [AF 61(052)30] Unclassified

Published in Zeitschr. für Anat. und Entwicklungsgeschichte, v. 121: 179-187, 1959.

The Canadian beaver is poorly cerebralized. The relation of the brain weight to the body weight is 1:330 (Castro canadensis carolinensis). The beaver brain is primarily lissencephalic. A short, irregular, parasagittal furrow, a homolog of the sulcus lateralis of lower mammals is found only on the dorsal surface of the large hemisphere of the brain. Corresponding to their position, a short jugum cerebrale is found on the endocranial surface of the Osparietale. The beaver brain of all the Sciuromorpha so far investigated is the most greatly developed relative to other parts of the brain. A relationship is seen between this strong cortex development and the psychic "achievements of the beaver". Above all the occipital part of sections of the end brain appears strongly developed. A next project will be to determine which cytoarchitectonic areals in this region have experienced a particular expansion. The higher differentiation in the neocortex is accompanied by several phylogenetically primitive characteristics: the very long Pars ocalis tuberis in the hypothalamus and a short bar which incompletely covers the thalamus. In spite of the notable water adaptation, the beaver is, according to the brain morphology, definitely macrosmatic. In the expanse of the smell centers, it is found (compared with other terricolar and arboricolar Sciuromorpha) that there is no reduction of these parts of the brain necessitated by the water life. Castor canadensis occupies a special position by ontogenetic considerations in the framework of its suborder (Sciuromorpha, Insessor). The propagation number according to Gortmann is 3.5, which corresponds to the ontogenetic type of autophagi. (Translation of Contractor's abstract)

111

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[THE BRAIN OF THE CHINCHILLA, AND COMPARATIVE ANATOMICAL OBSERVATIONS WITH RELATED SPECIES OF RODENTS (RODENTIA, HYSTRICORMORPHA)] Das Gehirn der Chinchillas und vergleichend-anatomische Betrachtungen mit verwandten Nagerarten (Rodentia, Hystricomorpha), by G. Pilleri. [1959] [18]p. incl. illus. diagrs. tables. [AF 61(052)30] Unclassified

Published in Acta Zool. (Stockholm), v. 40: 23-41, 1959.

In the 1st part, the brains of Chinchilla laniger and Chinchilla brevicaudata were described. In the 2nd part, these findings were treated on a comparative anatomical basis along with other Hystricomorpha (Cava, Dolichotis, Hydrochoerus, Cuniculus, Dasyprocta, Lagostomus), - predominantly quantitative relationships were studied. Animals with a large body weight are, in general, poorly cerebralized, and vice versa. A further correlation exists between body weight and the degree of gyration in the cortex of the telencephalon, the largest species exhibiting the greatest degree of gyration. A new index has been introduced which describes paleoneocortical relationships in the macroscopic preparation. A direct relationship exists between this index and the degree of gyration - the greater the degree of gyration, the less relative size of the paleocortex, and vice versa. In various species, the size of the cerebellum is not proportional to the size of the cerebrum. With the basic form of the cerebellum preserved, the length of the paraflocculus undergoes great variations. These are species or genus connected characteristics, which express a particular central nervous specialization.

112

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[THE BRAINS OF DOLICHOTIS PATAGONA AND HYDROCHOERUS HYDROCHAERIS, WITH OBSERVATIONS ON ENDOCRANIAL RELATIONSHIPS (RODENTIA, HYSTRICOMORPHA)] Das Gehirn von Dolichotis patagona und Hydrochoerus hydrochaeris, nebst Betrachtungen über die endocraniellen Verhältnisse (Rodentia, Hystricomorpha), by G. Pilleri. [1959] [16]p. incl. illus. diagrs. table, refs. [AF 61(052)30] Unclassified

Published in Acta Zool. (Stockholm), v. 40: 43-58, 1959.

The brains of Dolichotis patagona and Hydrochoerus hydrochaeris have been described, and their relief compared to the structure of the endocranium. The Hydrochaerus brain, which is more strongly gyrated, corresponds to the endocranium which is poor in relief or even smooth, while Dolichotis exhibits a pronounced endocranial relief. With reference to the theory of Spatz this fact is related to cerebral evolution. In accordance with this theory, the Hydrochoerus brain has reached, and long since passed, the high point of its differentiation, thus losing its "propulsivity" on the endocranium. The Dolichotis patagona, however, would still be capable of differentiation or have just attained the high point of its evolution.

113

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[THE BRAINS OF PARADOLICHOTIS SALINICOLA AND DOLICHOTIS PATAGONA (RODENTIA, HYSTRICOMORPHA) Das Gehirn von Paradolichotis salinicola und Dolichotis patagona (Rodentia, Hystricomorpha), by G. Pilleri. [1959] [8]p. incl. illus. diagrs. tables, refs. [AF 61(052)30] Unclassified

Published in Zeitschr. für Anat. und Entwicklungeschichte, v. 121: 141-148, 1959.

A significant difference of the neocortical development of Paradolichotis salinicola and Dolichotis patagona arises from the analysis of the brain of the two related species. It is to attribute a taxonomical value to this dissimilarity in the central nervous system. Dolichotis

patagona. as regards the brain morphology, is more strongly differentiated than Paradolichotis salinicola. (Translation of Contractor's abstract)

114

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[THE CENTRAL NERVOUS SYSTEM OF CASTOR CANADENSIS, KUHL.] Das Zentralnervensystem des Castor canadensis, Kuhl, by G. Pilleri. [1959] [36]p. incl. illus. diagrs. tables, refs. [AF 61(052)30]
Unclassified

Published in Acta Zool. (Stockholm), v. 40: 105-140, 1959.

The results from the macroscopic investigation of the brain of the beaver (Castor canadensis, Kuhl), are as follows: The ratio of brain weight to body weight = 1:330 (C. canadensis carolinensis, Rhoads). This corresponds to a low level of cephalization when compared with the quotients of lower rodents such as Epimys norvegicus (= 1:95). The quotient, hypothalamus - length: length of cerebrum, as an expression of central nervous differentiation, lies between 0.20 and 0.24 in the beaver, which would indicate a highly developed brain in the frame of the Sciuromorpha. The extension of the bulbus, tractus olfactorius and the other formations of the rhinencephalon (lobus pyriformis, habenula, etc.) clearly indicate the beaver brain as the central nervous organ of a macrosmatic animal, despite the beavers' amphibious way of life. The neocortex is greatly expanded, with the formation of markedly projecting poles, which are best considered by means of the angle procedure of Schneider (Anatomical Inst. Frankfurt a.M.). The cerebral cortex, with the exception of a short sulcus lateralis, is smooth. The ventricles are wide and the nervous opticus is thin. The hypophysis, especially the adenohypophysis, is strongly developed. The pars oralis tuberis of the hypothalamus is long. The cerebellum is very well developed, especially in the hemispheres, and the paraflocculi are very pronounced and project sidewards. The corpus callosum is short and does not completely cover the thalamus. In the beaver brain, phylogenetically primitive signs such as short corpus callosum and long pars oralis tuberis were observed together with characteristics such as the neocortex which indicate a greater degree of differentiation.

115

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[COMPARATIVE MORPHOLOGY OF RODENT BRAINS: MACROSCOPIC AND COMPARATIVE ANATOMICAL STUDIES OF THE CENTRAL NERVOUS SYSTEM OF RODENTS. PART I. SCIUROMORPHA] Beiträge zur vergleichenden Morphologie des Nagetiergehirnes: Makroskopische und vergleichendanatomische Betrachtungen über das Zentralnervensystem der Nagetiere. 1. Beitrag: Sciuromorpha, by G. Pilleri. [1959] [42]p. incl. illus. diagrs. tables, refs. [AF 61(052)30]
Unclassified

Published in Acta Anat., Suppl. 38: 1-42, 1959.

The macroscopic appearance of 13 Sciuromorpha brains are described and in part illustrated. Good results were obtained in the study of the brain shape by Schneider's angle method. These appear to be species-bound characteristics, and are not morphological signs particular to the higher systematic units. Aside from the primitive folds (Ariëns Kappers), the species studied showed, as a whole, an extremely lissencephalic type brain. A short sulcus lateralis can be clearly recognized on the dorsal surface of the cerebral hemisphere of only the beaver and it is only indicated on the marmot brain. The shape and size of the cerebellum are compared in all the species studied. The paleoneocortical relationships are established macroscopically by means of a new index. In the index of hypothalamus length: a further expression of neocortical development is observed in the cerebral length. A comparison of the average of both indices with those of the Hystricomorpha confirms the view of Wirz and Portmann that the Sciuromorpha, in so far as their order is concerned, should be placed after the Hystricomorpha and before the Myomorpha. Because of its unusual form, the beaver receives special comparative-neurological consideration. In addition to its clear primitive markings (short corpus callosum, long pars oralis tuberis, extended paleoneocortex), the beaver brain shows signs which speak for a higher differentiation (hypothalamus index: 0.20, strong occipitalisation). (Contractor's abstract in part)

116

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[COMPARATIVE MORPHOLOGY OF RODENT BRAINS: MACROSCOPIC AND COMPARATIVE ANATOMICAL STUDIES OF THE CENTRAL NERVOUS SYSTEM OF RODENTS. PART 2. HYSTRICOMORPHA] Beiträge zur vergleichenden Morphologie des Nagetiergehirnes: Makroskopische und vergleichend-anatomische Betrachtungen über das Zentralnervensystem der Nagetiere. 2. Beitrag: Hystricomorpha, by G. Pilleri. [1959] [53]p. incl. illus. diagrs. tables, refs. [AF 61-(052)30]
Unclassified

Published in Acta Anat., Suppl. 38: 43-95, 1959.

The brains of 16 Hystricomorpha species are described according to their macroscopic, dimensional and comparative anatomical aspects. The studies are primarily concerned with the telencephalon, hypothalamus and cerebellum of the Hystricomorpha whose general and specific characteristics are compared with those of the Sciuromorpha. The problem of cephalisation is also considered. Because of the limited material available questions concerning homology, relationship to systemics and ecology could only be touched upon. Hence, this work can only be considered as an introduction to

further investigations to be carried out within the particular species. (Contractor's abstract, modified)

117

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[COMPARATIVE MORPHOLOGY OF RODENT BRAINS: MACROSCOPIC AND COMPARATIVE ANATOMICAL STUDIES OF THE CENTRAL NERVOUS SYSTEM OF RODENTS. PART 3. THE BRAIN OF AQUATIC RODENT (CASTOR CANADENSIS, ONDATRA ZIBETHICA, MYOCASTOR COYPUS)] Beiträge zur vergleichenden Morphologie des Nagetieregehirnes: Makroskopische und vergleichend-anatomische Betrachtungen über Zentralnervensystem der Nagetiere. 3. Beitrag: Das Gehirn der Wassermager (Castor canadensis, Ondatra zibethica, Myocastor coypus), by G. Pilleri. [1959] [29]p. incl. illus. diagrs. tables, refs. [AF 61(052)30] Unclassified

Published in Acta Anat., Suppl. 38: 96-124, 1959.

After briefly reviewing the biological aspects of the beaver (Castor canadensis), the musk-rat (Ondata zibethica) and nutria (Myocastor coypus), the macroscopic anatomy of the brains of these aquatic rodents are described and some of the brain regions (rhinencephalon, neocortex and cerebellum) are compared with those of related terrestrial rodents of three suborders. These studies reveal that in all 3 aquatic representatives the rhinencephalon is as well developed as in the terrestrial members of the same sub-order or, as in the case of the beaver, it is even better developed. Therefore, aquatic life did not cause reversion of the olfactory organs of the water rodents as in some of the Carnivora or Cetacea. In so far as can be determined macroscopically the neocortex is well developed in all 3 species. The hemisphere of the cerebellum and the paraflocculus appear to be well developed in the water rodents, this apparently being related to their aquatic life. However, a quantitative comparison reveals that the indices do not represent extremes; they are often surpassed by specialized terrestrial forms of the same sub-order. Compared among themselves the beaver, musk-rat and nutria show many similarities in respect to brain form and the results of the index determinations. Of all the aquatic rodents the beaver has the most strongly developed Tuberculum olfactorium, neocortex and cerebellum. More precise quantitative comparative values for those brain regions not yet studied will be reported on when the specimens have been prepared for histologic study. (Contractor's abstract)

118

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[THE MORPHOLOGY AND POSTEMBRYONIC DEVELOPMENT OF THE BRAIN OF DASYPROCTA AGUTI. LIN. (RODENTIA, HYSTRICOMORPHA)] Zur Morphologie und postembryonalen Entwicklung des Gehirnes von Dasyprocta aguti. Lin. (Rodentia, Hystricomorpha), by G. Pilleri. [1959] [10]p. [AF 61(052)30] Unclassified

Published in Rev. Suisse Zool., v. 66: 545-553, 1959.

Gross anatomical measurements are given for the brains of 1 adult D. azarae, and of 3 adults and 1 newborn D. aguti. The ratio, brain weight: body weight is 1:21 in newborn, and 1.116 in adult D. aguti. Adult brain weight: newborn brain weight is 2.7, as in precocial birds. Dasyprocta are born in an advanced state of development.

119

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[ON THE BRAINS OF SOME DASYPROCTINAE RODENTIA-HYSTRICOMORPHA, DASYPROCIDAE)] Ueber das Zentralnervensystem einiger Dasyprocinae (Rodentia, Hystricomorpha), by G. Pilleri. [1959] [8]p. incl. illus. [AF 61(052)30] Unclassified

Published in Rev. Suisse Zool., v. 66: 633-639, 1959.

Gross morphological measurements are given for brains of adult Myoprocta acouchy, Dasyprocta mexicana and Dasyprocta aguti, of subfamily Dasyproctinae, in comparison with data for Cuniculus paca of subfamily Cuniculanae.

120

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[ONTOGENY AND CEREBRALIZATION IN THE BEAVER (C. CANADENSIS, KUHL)] Ontogenese und Cerebralisation beim Biber (Castor canadensis, Kuhl), by G. Pilleri. [1959] [10]p. incl. illus. [AF 61(052)30] Unclassified

Published in Rev. Suisse Zool., v. 66: 165-174, 1959.

Measurements are given for the appendages and major parts of the brain for 3 individuals: fetus (270 mm body length), newborn (300 mm) and adult.

121

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[COMPARATIVE ANATOMICAL INVESTIGATIONS ON THE CENTRAL NERVOUS SYSTEM OF RODENTS, AND RELATIONSHIPS BETWEEN BRAIN FORM AND TAXONOMY] Bestimmung der zentralnervösen Rangordnung der Magetiere und Beziehungen zwischen Hirnform und Systematk, by G. Pilleri. [1960] [14]p. [AF 61(052)30] Unclassified

Published in Rev. Suisse Zool., v. 67: 373-386, 1960.

Taxonomic characteristics in the brain have been defined in representatives of the families of Sciuromorpha. They indicate the possibility of a relationship between brain form and systematics, which may be particularly important in orders such as Rodentia, in which systematics are often difficult and arrangements doubtful. Dichotomic groupings are demonstrated in "brain keys" to the families of Sciuromorpha, to select genera of Sciuromorpha, and the species of Marmoto.

122

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[COMPARATIVE MORPHOLOGY OF RODENT BRAINS: PART 4. CENTRAL NERVOUS SYSTEM, VISCERA AND PHYLOGENETIC RELATIONSHIPS OF APLODONTIA RUFA] Beiträge zur vergleichenden Morphologie des Nagetiergehirnes: 4. Beitrag: Zentralnervensystem, Körperogane und stammesgeschichtliche Verwandtschaft der Aplodentia rufa Rafinesque (Rodentia, Aplodontoidea), by G. Pilleri. [1960] [31]p. incl. illus. diagrs. tables, refs. [AF 61(052)30] Unclassified

Published in Acta Anat., Suppl. 41: 5-35, 1960.

The structure of the oral cavity is described. Only 2 folds are found in the palatal mucosa, instead of 4 as stated by Tullberg. Fungiform papillae are found over the entire dorsal surface of the tongue, mixed with circumvallate papillae, instead of the 2 being restricted to separate areas as reported by Tullberg. The salivary glands are described and illustrated. The stomach has a coiled diverticulum at the cardiac end. Each lung is composed of 3 lobes, in contrast to Tullberg's observations. There are paired anterior venae cavae. The endocrine glands are similar to those of the other rodents. The brain seems somewhat, but not exceedingly, primitive for a rodent, especially well shown in the small size of the neopallium. The visual areas and the optic nerve are reduced. This also occurs in other burrowing forms. The closest similiarities of the brain are with that of the bathyergid, Heterocephalus. This latter also has paired anterior venae cavae which seem to indicate relationship between Apolodontidae and the Bathyergidae, and to separate both from the Sciurodea, Castoridae, Geomyoidea, and other rodents. The Sciurodea and Castoridae are very similar in the morphology, both of the cerebrum and of the cerebellum.

123

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[COMPARATIVE MORPHOLOGY OF RODENT BRAINS: PART 5. COMPARATIVE ANATOMY OF THE CENTRAL NERVOUS SYSTEM OF NEARCTIC SCIUROMORPHA AND REMARKS ON THE PROBLEM OF BRAIN FORM AND TAXONOMY] Beiträge zur vergleichenden Morphologie des Nagetiergehirns: 5. Beitrag: Vergleichend-morphologische Untersuchungen über das Zentralnervensystem nearktischer Sciuromorpha und Bemerkungen zum Problem Hirnform und Taxonomie, by G. Pilleri. [1960] [33]p. incl. illus. diagrs. tables, refs. [AF 61(052)30] Unclassified

Published in Acta Anat., Suppl. 41: 36-38, 1960.

Descriptions are given of the brains of Sciurus niger, Tamiasciurus hudsonicus, Marmota flaviventris, M. monax, Citellus tridecemlineatus, Tamias striatus and Perognathus parvus. All cerebra were smooth, only that of M. flaviventris showing the beginnings of fissuring. The brain characteristics are summarized for each of the living families placed in the Sciuromorpha by Simpson (1945). The brain of Pedetes is quite different from the others, and much more like that of the Hystricomorpha. Although there are many questions as to whether brain morphology can yet be used to determine the phylogenetic relationships of forms, it is nevertheless possible to make a key to the brain characteristics of families, of genera within Sciurodae and species of Marmota.

124

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[COMPARATIVE MORPHOLOGY OF RODENT BRAINS: PART 6. COMPARATIVE ANATOMY OF THE BRAIN OF THE MYOMORPHA] Beiträge zur vergleichenden Morphologie des Nagetiergehirns: 6. Beitrag: Materialien zur vergleichenden Anatomie des Gehirnes der Myomorpha, by G. Pilleri. [1960] [20]p. incl. illus. diagrs. tables. [AF 61(052)30] Unclassified

Published in Acta Anat., Suppl. 41: 69-88, 1960.

Descriptions are given of the brains of the following 9 species: Peromyscus sp., Sigmodon hispidus, Cricetus auratus, Arvicola terrestris, Ondatra zibethica, Microtus arvalis, Rattus norvegicus, R. rattus, and Mus musculus. All these forms have smooth cerebra, with a poorly developed neocortex, dorsal exposure of the corpora quadrigemina, and a relatively undifferentiated cerebellum. Using the central nervous system as a criterion, the Myomorpha are much more primitive than the Sciuromorpha or Hystricomorpha. There are considerable differences between Rattus norvegicus and R. rattus. The brain of Pectinator (Ctenodactylidae) is discussed and considered to have characteristics suggestive both of myomorphs and hystricomorphs, especially of Chinchilla. Whether these are due to convergence of whether Pectinator is a phylogenetic intermediate cannot be determined without additional material.

125

[Bern U. Brain Research Inst., Waldau-Bern (Switzerland)].

[CONCERNING THE CENTRAL NERVOUS SYSTEM OF HETEROCEPHALUS GLABES (RODENTIA, BATHYERGIDAE)] Über das Zentralnervensystem von

Heterocephalus glaber (Rodentia, Bathyergidae), by G. Pilleri. [1960] [11]p. incl. illus. diagrs. [AF 61(052)-30] Unclassified

Published in Acta Zool. (Stockholm), v. 41: 101-111, 1960.

The gross anatomy of the brain of Heterocephalus is described: the optical system is vestigial; the cerebellum has a very primitive structure and the colloculi inferiores of the lamina quadrigemina are extremely reduced; the fissura rhinalis is not visible macroscopically. Several features in the brain remind of the conditions in Myomorpha. On the other hand the extreme reduction of various areas in the brain indicate the systematic position of a suborder as suggested by Wood (Jour. Mammal., v. 36: 165-187, 1955).

126

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[THE MORPHOLOGY OF THE CENTRAL NERVOUS SYSTEM OF ERETHIZON DORSATUM, LINNEAUS (RODENTIA, HYSTRICOMORPHA)] Zur Morphologie des Zentralnervensystems von Erethizon dorsatum, Linneaus (Rodentia, Hystricomorpha), by G. Pilleri. [1960] [7]p. incl. illus. diagrs. tables, refs. [AF 61-(052)30] Unclassified

Published in Zeitschr. für Anat. und Entwicklungegeschichte, v. 121: 369-375, 1960.

The brain of Erethizon dorsatum (E. dorsatum dorsatum, Linnaeus, 1758) is described. It is given by the analysis of 6 brains of the same subspecies which shows a strong variability in the form of the hemispheres. The quotient of the lengths of the hypothalamus: the gross brain length fluctuates between 0.21 and 0.29 with a mean value of 0.25. A value of 0.26 was calculated for Hystrix cristata, hodgsoni and javanicus. The difference between Erethizontiae and Hystricinae for hypothalamus quotients is very small, although they arise from different superfamilies. In contrast, Atherurinae 'Atherurus africanus centralis, Thomas) show a quotient of 0.32, although they belong to the superfamily Hystricoidea. The greater quotient would indicate a lower stage of neocortical development in Atherurinae. Ordered by increasing central nervous system differentiation is the following list: (1) Atherurus; (2) Erethizon; and (3) Hystrix. The relation of the brain weight (= 1) to the body weight is 1:187 for Erethizon dorsatum. (Translation of Contractor's abstract)

127

Bern U. Brain Research Inst., Waldau-Bern (Switzerland).

[STEREOTYPED BEHAVIOR IN THE NORTH AMERICAN OPOSSUM (DIDELPHIS VIRGINIANA, MARSUPIALIA)] Bewegungsstereotypien beim nordamerikanischen Opossum (Didelphis virginiana, Marsupialia), by G. Pilleri. [1960] [3]p. [AF 61(052)30] Unclassified

Published in Rev. Suisse Zool., v. 67: 519-521, 1960.

Stereotyped activity by one young female occurred for hours every day as long as the animal was kept on a reversed sleeping rhythm (caged at night, freed to feed in daytime) and was unable to get into a dark shelter during the daytime.

128

Birmingham U. Dept. of Chemistry (Gt. Brit.).

RESEARCH IN MICROWAVE SPECTROSCOPY, by J. Sheridan. Summary rept. no. 1. Sept. 1, 1959-Dec. 31, 1960, 6p. (AFOSR-1106) (AF 61(052)241) AD 262030 Unclassified

Methods of fabrication of miniaturized point-contact harmonic generators and detectors of millimeter-wave spectroscopy were developed which are efficiently reproducible and available for general spectroscopic use. Various methods of assembly, and a variety of semiconducting materials, were assessed, and work was begun on ion-bombardment of semi-conductors for harmonic generation. A number of spectroscopic measurements were made partly during tests of harmonic generation, and partly with high-sensitivity spectrometers in the conventional microwave range. The analysis of some of the measurements in terms of molecular structures proved, in some cases, complex enough to require fairly extended computations, which are to be continued. In contrast, new measurements on certain isotopic species of simple molecules showed the need for revision of certain details of their structures. (Contractor's abstract)

129

Birmingham U. Dept. of Experimental Psychiatry (Gt. Brit.).

THE EFFECTS OF DRUGS ON CONDITIONING AND HABITUATION TO AROUSAL STIMULI IN ANIMALS, by B. J. Key and P. B. Bradley. [1960] [13]p. incl. diagrs. refs. (AF 61(514)1184) Unclassified

Published in Psychopharmacologia, v. 1: 450-462, Nov. 1960.

The effects of a number of drugs on conditioned and unconditioned arousal responses (behavioral and electroencephalographic) produced by auditory stimuli in cats are reported. Positive conditioning was achieved by pairing certain auditory stimuli with a painful stimulus (electric shock). Chlorpromazine increases thresholds for both conditioned and unconditioned stimuli and eventually blocks arousal responses completely. Reserpine, which has a delayed effect, causes only a slight rise in the conditioned response but blocks the

unconditioned response although this later effect may have been due to habituation. Amphetamine causes a fall in the threshold for unconditioned arousal responses but does not change that for conditioned responses. However, these thresholds can no longer be assessed when doses which produced full alerting were used. LSD 25 also causes a fall in the threshold for arousal to unconditioned stimulus and no change in the conditioned response, but it restores the response to a stimulus which has previously been habituated. The results are discussed in relation to the hypothesis for the sites of action of these drugs in the brain which has been expounded previously. (Contractor's abstract)

130

Birmingham U. Dept. of Industrial Metallurgy (Gt. Brit.).

RESEARCH ON STRAIN-AGEING, HARDENING AND SOFTENING OF METALS BY FATIGUE. PART I. FATIGUE OF ALUMINUM-MAGNESIUM ALLOYS, by G. W. J. Waldron and T. Broom. PART II. FATIGUE OF ZINC SINGLE CRYSTALS, by J. M. Summerton and T. Broom. Final rept. Aug. 1960 [90]p. incl. illus. diagrs. refs. (AFOSR-TR-60-170) (AF 61(514)1182) AD 246965; PB 153298 Unclassified

Part I: Extruded Al-Mg alloys have high ratios of fatigue to tensile properties and their S-N curves show fatigue limits. These excellent fatigue properties are believed to be due to Mg atoms at dislocation lines inhibiting cross-slip. Metallographic work and single-crystal experiments support this hypothesis. Polycrystals of Al and Al-Mg show hardening behavior after fatigue which is probably at least partially due to vacancies produced during the fatigue process. Evidence is advanced for supposing that the lowest stress for fatigue failure in Al and Al-Mg alloys may be correlated with the stress for beginning of cross-slip. Part II: Zn single crystals were fatigued at -196, -78, and 20°C, in push-pull tests at 100 cycles. In tests at 20°C the S-N curves of specimens having X(chi) between 30 and 60° superimpose when plotted in terms of resolved shear stress on the basal plane. Prismatic (1010) slip was observed on specimens fatigued at -78 and 20°C, and a possible hardening mechanism whereby dislocations on basal and prismatic planes can interact is considered. Specimens fatigued at -196°C show a yield extension in a subsequent tensile test; aging between -120 and 40°C after fatigue increases the stress at which yielding occurs. Specimens fatigue-hardened at -196 and -78°C have a strong temperature dependence of flow stress.

131

Bolt, Beranek and Newman, Inc., Cambridge, Mass.

ON PSYCHOPHYSIOLOGICAL MODELS, by J. C. R. Licklider. [1959] [24]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1190) (AF 49(638)355) Unclassified

Published in Sensory Communication: Contributions to the Symposium on Principles of Sensory Communication, Endicott House, M.I.T. (July 19-Aug. 1, 1959) [Cambridge] M.I.T. Press, 1961, p. 49-72. (AFOSR-796)

"Audio analgesia" is acoustically induced suppression of pain. The phenomenon is genuine but complex and not yet well understood. Most of our knowledge about it comes from clinical (especially dental) experience. The present aim is to clarify understanding of audio analgesia by bringing the established characteristics of the phenomenon into relation with one another, and with a few basic psychophysiological ideas, through the agency of a mathematical (or computer) model. The model is a very simple one. It involves two channels ("hearing" and "pain") each with positive and negative feedback paths to itself and to the other channel. The dynamic behavior of the model is determined by amplification, biasing, and smoothing parameters associated with the feedback paths. With values of those parameters that are reasonable on a priori ground, the behavior of the model reflects many of the characteristics of audio analgesia.

132

Bolt, Beranek and Newman, Inc., Cambridge, Mass.

MAN-COMPUTER SYMBIOSIS, by J. C. R. Licklider. Mar. 1960 [8]p. incl. refs. (AFOSR-TN-60-1191) (AF 49(638)355) AD 247346 Unclassified

Also published in I.R.E. Trans. on Human Factors in Electronics, v. HFE-1: 4-11, Mar. 1960.

Man-computer symbiosis is an expected development in cooperative interaction between men and electronic computers. It will involve very close coupling between the human and the electronic members of the partnership. The main aims are (1) to let computers facilitate formulative thinking as they now facilitate the solution of formulated problems, and (2) to enable men and computers to cooperate in making decisions and controlling complex situations without inflexible dependence on predetermined programs. In the anticipated symbiotic partnership, men will set the goals, formulate the hypotheses, determine the criteria, and perform the evaluations. Computing machines will do the routinizable work that must be done to prepare the way for insights and decisions in technical and scientific thinking. Preliminary analyses indicate that the symbiotic partnership will perform intellectual operations much more effectively than man alone can perform them. Prerequisites for the achievement of the effective, cooperative association include developments in computer time sharing, in memory components, in memory organization, in programming languages, and in input and output equipment. (Contractor's abstract)

133

Boston U. Dept. of Chemistry, Mass.

NONDEGRADATIVE REACTION OF "ACTIVE NITROGEN" WITH CONJUGATED DIENES, by A. Tsukamoto and N. N. Lichtin. June 3, 1960, 3p. (AFOSR-TN-60-607) (AF 49(638)2) AD 239940; PB 149219
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 3798-3799, July 20, 1960.

Experiments were carried out to explore the possibility that "active" N_2 reacts under suitable circumstances to yield relatively simple products without deep-seated molecular disruption and towards elucidating chemical mechanism for such processes. Initial experiments with 1,3-butadiene confirmed observations that with isoprene as the substrate, "a nitrogenous low-boiling liquid in good yield and generating NH_3 on hydrolysis is produced." Analysis on the yields of the gas phase reaction of "active" N_2 with butadiene at room temperature in a conventional Pyrex flow system indicated 4 major fractions of the "high boiling" product, i.e. pyrrole (~30%); trans-crotononitrile (~15%), an unsaturated nitrile (~10%); and an uncharacterized component (~10%). Conclusive discussion of mechanism on the basis of these results would be premature, however, it can be emphasized that both pyrrole and crotononitrile are products of the addition of a nitrogen atom and loss of one hydrogen atom from the substrate. The product distribution depended upon the substrate flow rate.

134

Boston U. [Dept. of Physics] Mass.

DIFFERENTIAL-OPERATOR APPROXIMATIONS TO THE LINEAR BOLTZMANN EQUATION, by A. Siegel. [1960] 45p. incl. refs. (AFOSR-TN-60-465) (AF 49-(638)675) Unclassified

Also published in Jour. Math. Phys., v. 1: 378-390, Sept.-Oct. 1960.

A measure of deviation from equilibrium of an ensemble of particles is proposed, which is physically appropriate and of especially simple form when expressed in terms of the expansion coefficients of the ensemble distribution function with respect to the system of orthogonal polynomials obtained by using the equilibrium distribution function as weight function. The linear Boltzmann operator can then be expanded in a series of terms which, under certain circumstances, may be regarded as successively diminishing magnitude in their effect on the rate of approach to equilibrium. This expansion of the operator is different from the expansion due to Kramers (later discussed by Moyal) in derivative moments, commonly used in approximate stochastic treatments of irreversible processes. With the aid of a theorem on definite operators, it is possible to break off the series at any point and thereby obtain a correspondingly accurate approximation to the linear Boltzmann operator, whose temporal solutions tend to the correct equilibrium distribution function. The first approximation is the Fokker-Planck operator, exactly. The next approximation would be the appropriate operator to use when the stochastic variable begins to deviate appreciably from a linear dissipation law, etc. The method is applied to the "Rayleigh process" (ensemble to particles in a rarefied gas medium, the medium itself being in internal equilibrium), and the second approximation to the linear Boltzmann operator for this case is explicitly derived. A possible form for the second approximation in more general processes, suggested by this, is also given. (Contractor's abstract)

135

Boston U. [Dept. of Physics] Mass.

A NEW EXPANSION OF THE DIFFERENTIAL OPERATOR FOR THE TIME DEVELOPMENT OF FLUCTUATION DISTRIBUTIONS, by A. Siegel. [1960] 6p. (AFOSR-TN-60-467) [AF 49(638)675] AD 287169
Unclassified

This is a preliminary report of AFOSR-TN-60-905 (item no. 136).

136

Boston U. [Dept. of Physics] Mass.

A NEW EXPANSION OF THE DIFFERENTIAL OPERATOR FOR THE TIME DEVELOPMENT OF FLUCTUATION DISTRIBUTION, by A. Siegel. [1960] 20p. (AFOSR-TN-60-905) [AF 49(638)675] Unclassified

Also published in Rarefied Gas Dynamics: Proc. Second Internat'l. Symposium, California U., Berkeley [Aug. 3-6, 1960] New York, Academic Press, 1961, p. 261-275.

It has been shown (see item no. 134) that, in the case of the "Rayleigh model," the linear Boltzmann operator has a power series expansion, in terms of a small parameter, whose successive terms demonstrably represent successively decreasing contributions to the equilibrium-seeking tendency of the system described; and that from this series it is possible to obtain successive negative-semidefinite approximations to the linear Boltzmann operator of increasing order in the expansion parameter. The lowest approximation is the Fokker-Planck operator, which thus takes on the character of the first in a sequence of approximations. This paper aims to generalize this result beyond the Rayleigh or any other special model. An expansion of the one-dimensional linear Boltzmann operator without reference to any special parameter is derived. Then a formal method is given for constructing successive negative-semidefinite approximations to this series, assuming it to be convergent with respect to the equilibrium-seeking

tendency. Finally, these approximations are applied to the computation of the corrections to the spectrum of a process obeying a linear Boltzmann equation. It is shown that the corrections are necessarily of second order in the perturbation.

137

Brandeis U. [Dept. of Physics] Waltham, Mass.

PERIODIC GROUND STATES AND THE MANY-BODY PROBLEM, by E. P. Gross. [1960] [6]p. (AFOSR-TN-60-586) [AF 49(638)27] Unclassified

Also published in Phys. Rev. Ltrs., v. 4: 599-601, June 15, 1960.

The possible existence of ground states with periodic Hartree-Fock wave-functions is discussed with references to earlier work. A general method is first described in which the periodic state forms the correct starting point. Then some qualitative and unusual features of such periodic states are noted.

138

Brandeis U. [Dept. of Physics] Waltham, Mass.

RELATIONSHIP BETWEEN SYSTEMS OF IMPENETRABLE BOSONS AND FERMIONS IN ONE DIMENSION (Abstract), by M. Girardeau. [1960] [1]p. [AF 49(638)27] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 8, Jan. 27, 1960.

A rigorous correspondence is established between the energy eigenfunctions of 1-dimensional systems of bosons and of spinless fermions with an arbitrary interaction having an impenetrable core. The energy spectra are identical while the Bose and Fermi eigenfunctions are related by $\psi^B = \psi^F A$ where $A(x_1 \cdots x_n)$ is + 1 or - 1 according as the order pq $\cdots$ r, when the x_j are arranged in the order $x_p < x_q < \cdots < x_r$, is an even or an odd permutation of 1 $\cdots$ n. All configurational probability distributions of the 2 systems are identical, but the momentum distributions are quite different. The theory is illustrated by application to impenetrable point particles in a box with periodicity lenght L. Since for spinless fermions point interactions are equivalent to no interaction, one can find the rigorous energy spectrum and eigenstates of the corresponding Bose system. For odd n the ground state ψ_0^B is $\pi_{j1'} |\sin [\pi L^{-1} (x_j - x_1)]|$; for even n it is twofold degenerate and slightly more complicated. The low excitations are phonons, the 1-phonon states approaching the Feynman form $\psi_0^B \Sigma_j \exp (ikx_j)$ as $k \to 0$.

139

Brandeis U. [Dept. of Physics] Waltham, Mass.

QUANTUM THEORY OF INTERACTING BOSONS, by E. P. Gross. [1960] [33]p. (AF 49(638)27) Unclassified

Published in Ann. Phys., v. 9: 292-324, Feb. 1960.

Some qualitative features of the ground state of a system of interacting bosons are discussed using wave functions suggested by the semiclassical theory of boson wave fields. For the case where one deals with weak repulsions, one is lead to a variational extension of Bogolyubov's work. A finite fraction of the N particles occupies the zero momentum single particle state, and the dynamic correlations are described by pair excitations. When attractive forces play a decisive role, two cases are found. In one case a finite fraction of the particles occupies a single particle state, which is now periodic in space. The dynamic correlations are described as a generalization of pair excitations which is different in character for excitation momenta of the order of the inverse of the range of the attractive forces. The single particle state and dynamic correlations are codetermined in a systematic way. The approximate ground state shows long range order which is destroyed at finite temperatures. A second case where attractions are important is the solid state of the boson system. The ground state has the property that of the order of N orthogonal single particle states are occupied, each with an average of approximately one particle. (Contractor's abstract)

140

Brandeis U. [Dept. of Physics] Waltham, Mass.

RECENT INVESTIGATIONS OF THE BOLTZMANN EQUATION, by E. P. Gross. [1960] [11]p. incl. refs. [AF 49(638)27] Unclassified

Published in Rarefied Gas Dynamics: Proc. First Internat'l. Symposium, Nice (France) [July 2-5, 1958], New York, Pergamon Press, 1960, p. 139-149.

Recent work pertaining to boundary value or initial value problems connected with the difficult integrodifferential equation of kinetic theory are first reviewed concerning (1) free molecular flow theory and differential iteration; (2) integral equation approach; (3) polynomial expansion methods; (4) discrete ordinate method; (5) inspired guesses; and (6) Enskog-Chapman method. Then the work on the theory of the linearized Boltzmann equation of E. A. Jackson and the author are described. The particular problems enumerated are: (1) propagation of sound disturbances in a monatomic gas; (2) steady state flow with parallel geometry; and (3) Rayleigh problem.

141

[Brandeis U. Dept. of Physics, Waltham, Mass.]

MOTION OF AN IMPURITY PARTICLE IN A BOSON SUPERFLUID, by M. Girardeau. [1960] [13]p. incl. diagrs. refs. [AF 49(638)27] Unclassified

Published in Phys. Fluids, v. 4: 279-291, Mar. 1961.

The problem of the low-lying spectrum of a system of many bosons and 1 impurity particle interacting by repulsive, central, 2-body forces is treated by first eliminating the dynamical variables of the impurity in terms of an added effective boson-boson interaction, and then treating the boson system by an extension of Bogolubov's method. In this way various physical properties of the clothed impurity particle, including its dispersion relation and effective mass, are obtained; singularities associated with the onset of acoustical wave drag as the impurity speed reaches the speed of sound in the boson medium are predicted. The parameters measuring the smallness of the corrections to the above results are shown to be the dimensionless boson-boson interaction, the dimensionless boson-impurity interaction, and the boson-impurity mass ratio. The treatment is then adapted to the case of hard spheres at low density by employing the Huang-Yang-Lee pseudopotential method; the results are valid if the dimensionless boson density and the boson-impurity mass ratio are small. A few remarks are made concerning the connection of the models treated with experimentally accessible results. (Contractor's abstract)

142

Brandeis U. Dept. of Physics, Waltham, Mass.

STRUCTURE OF THE FORWARD SCATTERING AMPLITUDE, by S. Deser, W. Gilbert, and E. C. G. Sudarshan. [1959] [7]p. incl. diagrs. (AFOSR-TN-60-88) (In cooperation with Harvard U. Lyman Lab. of Physics, Cambridge, Mass., AF 49(638)589) (AF 49-(638)636) AD 241686 Unclassified

Also published in Phys. Rev., v. 117: 266-272, Jan. 1, 1960.

The matrix elements of various products of 2 currents between states of equal energy-momentum are studied. Use of the axioms of local field theory leads to an integral representation for the Fourier transform of matrix elements of the retarded commutator in terms of 2 invariant momentum parameters. Further restriction on the class of allowed functions permits explicit incorporation of the mass restrictions as support conditions on the weight function. The "bound-state" term is separated off and related to the vertex functions. As a simple application, forward-scattering dispersion relations are derived by specialization of the Green's function. In particular, these can be obtained for nucleon-nucleon and K-meson-nucleon scattering. (Contractor's abstract)

143

Brandeis U. Dept. of Physics, Waltham, Mass.

INTEGRAL REPRESENTATIONS OF TWO-POINT FUNCTIONS, by S. Deser, W. Gilbert, and E. C. G. Sudarshan. [1959] [7]p. incl. diagrs. (AFOSR-TN-60-89) (In cooperation with Harvard U. Lyman Lab. of Physics, Cambridge, Mass., AF 49(638)589) (AF 49-(638)636) AD 241708 Unclassified

Also published in Phys. Rev., v. 117: 273-279, Jan. 1, 1960.

An integral representation for a general matrix element of 2 field operators between eigenstates labelled by an arbitrary number of momenta is presented. This representation is conveniently parametrized over a set of invariants related to the total momentum and momentum transfer, and explicitly incorporates spectral conditions. Physically interesting dispersion relations for off-forward scattering cannot be obtained from this representation alone. (Contractor's abstract)

144

Brandeis U. Dept. of Physics, Waltham, Mass.

CONSISTENCY OF THE CANONICAL REDUCTION OF GENERAL RELATIVITY, by R. Arnowitt, S. Deser, and C. W. Misner. [1960] [23]p. incl. refs. (AFOSR-TN-60-479) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)636 and National Science Foundation) Unclassified

Also published in Jour. Math. Phys., v. 1: 434-439, Sept.-Oct. 1960.

The question of consistency of the canonical reduction of general relativity (obtained by eliminating constraints and also imposing coordinate conditions in the action or generator) is examined. It is shown that the equations of motion obtained from this "reduced" formalism agree with the original Einstein equations. Agreement is also established for the generators of space-time translations. In order to establish consistency, it is necessary to discard certain well defined divergence terms in the original Lagrangian. These would otherwise appear as non-divergences in the reduced Lagrangian, incorrectly altering the equations. (Contractor's abstract)

145

Brandeis U. Dept. of Physics, Waltham, Mass.

INTERIOR SCHWARZSCHILD SOLUTIONS AND

INTERPRETATION OF SOURCE TERMS, by R. Arnowitt, S. Deser, and C. W. Misner. [1960] [16]p. (AFOSR-TN-60-481) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)636 and National Science Foundation) Unclassified

Also published in Phys. Rev., v. 120: 321-324, Oct. 1, 1960.

The solutions of the Einstein field equations, previously used in deriving the self-energy of a point charge, are shown to be non-singular in a canonical frame, except at the position of the particle. A distribution of "dust" of finite extension is examined as the model whose limit is the point particle. The standard "proper rest-mass density" is related to the bare rest-mass density. The lack of singularity of the initial metric $g_{\mu\nu}$ is in contrast to the Schwarzschild type singularity of standard coordinate systems. Our solutions for the extended source are non-static in general, corresponding to the fact that a charged dust is not generally in equilibrium. However, the solutions become static in the point limit for all values of the bare source parameters. Similarly, the self-stresses vanish for the point particle. Thus, a classical point electron is stable, the gravitational interaction canceling the electrostatic self-force, without the need for any extraneous "cohesive" forces. (Contractor's abstract)

146

Brandeis U. Dept. of Physics, Waltham, Mass.

GRAVITATIONAL-ELECTROMAGNETIC COUPLING AND THE CLASSICAL SELF-ENERGY PROBLEM, by R. Arnowitt, S. Deser, and C. W. Misner. [1960] 26p. incl. refs. (AFOSR-TN-60-482) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)636 and National Science Foundation) AD 613317 Unclassified

Also published in Phys. Rev., v. 120: 313-320, Oct. 1, 1960.

The gravitational effect on the classical Coulomb self-energy of a point charge is calculated rigorously. It is shown that the total mass then becomes finite (although still quite large), and that it depends only on the charge and not on the bare mechanical mass. Thus, a particle acquires mass only when it has non-gravitational interactions with fields of non-zero range. In order to treat this problem, it is necessary to extend the canonical formalism, previously obtained for the free gravitational field, to include coupling with the Maxwell field and the point charge system. It is shown that the canonical variables of the gravitational field are unaltered while those of the matter system are natural generalizations of their flat space forms. The determination of the total energy of a state can still be made from knowledge of the spatial metric at a given time. The self-mass of a particle is then the total energy of a pure one-particle state, i.e., a state containing no excitations of the canonical variables of the Maxwell or Einstein fields. Solutions corresponding to pure particle states of two like charges are also obtained, and their energy is shown consistent with the one-particle results. (Contractor's abstract)

147

Brandeis U. Dept. of Physics, Waltham, Mass.

NOTE ON POSITIVE-DEFINITENESS OF THE ENERGY OF THE GRAVITATIONAL FIELD, by R. Arnowitt, S Deser, and C. W. Misner. [1960] 9p. (AFOSR-TN-60-1263) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)636 and National Science Foundation) AD 246423 Unclassified

Also published in Ann. Phys., v. 11: 116-121, Sept. 1960.

The energy of the gravitational field is shown to be positive-definite for the case where initially (a) the spatial metric g_{ij} can be made isotropic and (b) the 2nd fundamental form $K_{ij} = -(-g^{00})^{-\frac{1}{2}}\Gamma^{0}_{ij}$ (which is essentially $\partial g_{ij}/\partial t$) is arbitrary apart from the coordinate condition $K = K_{ij}{}^{3}g^{ij} = 0$ defining the initial t = const surface. Physically, this situation corresponds to no wave excitations initially in g_{ij}, but arbitrary ones in K_{ij}. More precisely, the 2 canonical coordinates of the field are initially zero, while their conjugate momenta are arbitrary. The total energy of the system is also positive when sources with positive energies are coupled to the gravitational field. Some aspects of the general problem (where g_{ij} is also arbitrary initially) are discussed.

148

Brazil U. Inst. de Biofisica, Rio de Janeiro.

BIOELECTROGENESIS, A COMPARATIVE SURVEY OF ITS MECHANISMS WITH PARTICULAR EMPHASIS ON ELECTRIC FISHES. PROCEEDINGS OF THE SYMPOSIUM ON COMPARATIVE BIOELECTROGENESIS, Rio de Janeiro (Brazil) (Aug. 24-29, 1959), ed. by C. Chagas and A. Paes de Carvalho. New York, Elsevier Publishing Co., 1931, 413p. incl. illus. diagrs. tables, refs. (AFOSR-1528) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)595], Brazil U., Brazilian Campaign for Higher Education, and United Nations Educational and Scientific Corp. Office) AD 265940 Unclassified

An attempt to reformulate the problem of fish electrogenesis is reflected by subdividing this book into the following 5 general sections: (1) Morphological data on electric organs; (2) physiology of electric organs; (3) the nervous control of the discharge; (4) ecology of electric fishes; and (5) basic mechanisms of production of discharge. A total of 26 papers are included. The discussion following each presentation is also included. A list of contributors and a subject index are given.

149

Brazil U. Inst. de Biofisica, Rio de Janeiro.

PROCEEDINGS OF THE SYMPOSIUM ON THE SPECIALIZED TISSUES OF THE HEART, Rio de Janeiro (Brazil) (Aug. 1960), ed. by A. Paes de Carvalho, W. Carlos de Mello, and B. F. Hoffman. New York, Elsevier Publishing Co., 1961, 218p. incl. illus. diagrs. refs. [AF 49(638)595] Unclassified

The titles of the papers in this volume are: (1) Expansions of the atrio-ventricular system in the atria; (2) Comparative anatomy and functional considerations of the cardiac conduction system; (3) The micromorphology of the developing ventricular muscle; (4) Electron-microscopic study of the developing heart muscle cell in thin sections of chick-embryo tissue culture; (5) Effects of chronotropic influences on subthreshold oscillations in the sino-atrial node; (6) Some aspects of the interrelationship between ions and electrical activity in the specialized tissues of the heart; (7) The potassium and chloride permeability in Purkinje fibers; (8) Cellular electrophysiology of the atrial specialized tissues; (9) Histological aspects of the atrio-ventricular node of the rabbit heart; (10) Electrical activity of the atrio-ventricular node; (11) Observations on atrio-ventricular conduction and on distribution of the impulse in the ventricles of ruminants and other mammals; (12) Propagation of impulses through the specialized tissues of the mammalian heart; and (13) Direct studies of the in situ specialized conducting system. A subject index is also given.

150

British Columbia U. Dept. of Mathematics, Vancouver (Canada).

PERMANENT PRESERVERS ON THE SPACE OF DOUBLY STOCHASTIC MATRICES, by B. N. Moyls, M. Marcus, and H. Minc. Aug. 1960, 8p. (AFOSR-11) (AF 49(638)776) AD 258986 Unclassified

Also published in Canad. Jour. Math., v. 14: 190-194, 1962.

Linear mappings which preserve the permanents of doubly stochastic matrices are considered. The set of doubly stochastic matrices of order n forms a convex polyhedron Ω_n in the space of real n-square matrices. Let T be a mapping of Ω_n into itself such that $T(\alpha A + \beta B) = \alpha T(A) + \beta T(B)$ and per T(A) = per A for A, B $\in \Omega_n$ and for real numbers $\alpha \geq 0$, $\beta \geq 0$, $\alpha + \beta = 1$. Then there exist fixed permutation matrices P and Q such that either T(A) = PAQ for all $A \in \Omega_n$, or T(A) = PA'Q for all $A \in \Omega_n$. (Contractor's abstract)

151

British Columbia U. Dept. of Mathematics, Vancouver (Canada).

ON THE RELATION BETWEEN THE DETERMINANT AND THE PERMANENT, by M. Marcus and H. Minc. Aug. 1960, 10p. (AFOSR-12) (AF 49(638)776) AD 258986 Unclassified

Also published in Illinois Jour. Math., v. 5: 376-381, Sept. 1961.

It is shown that for $n \geq 3$, there exists no linear operation T on M_n such that per (TX) = det X for all $X \in M_n$. In case n = 2, such transformations do exist and are exhibited. The results stated above are both deduced as special cases of more general theorems on linear transformations T of $M_{m,n}$, the space of m x n matrices over F. For a matrix $X \in M_{m,n}$ the r^{th} permanental compound, $P_r(X)$ is defined as the $\binom{m}{r} \times \binom{n}{r}$ matrix whose entries are the permanents of the r x r submatrices of X, arranged in doubly lexicographic order. The problem treated in a later paper (see item no. 152) is then the determination of the structure of T under the assumption that for some r, $2 < r \leq \min(m,n)$ there exists a linear map S of $M_{\binom{m}{r}, \binom{n}{r}}$ into itself such (1) $P_r(T(X)) = S(P_r(X))$ for all $X \in M_{m,n}$. Condition (1) reduced to per T(X) = per X when r = m = n and S is the identity. The problem treated in this paper is $X \in M_{m,n}$, where S is a linear transformation on $M_{\binom{m}{r}, \binom{n}{r}}$ and $C_r(X)$ is the r^{th} compound matrix of X. (Contractor's abstract)

152

British Columbia U. Dept. of Mathematics, Vancouver (Canada).

THE PERMANENT FUNCTION, by M. Marcus and F. C. May. Aug. 1960, 24p. incl. refs. (AFOSR-13) (AF 49(638)776) AD 258986 Unclassified

Also published in Canad. Jour. Math., v. 14: 177-189, 1962.

Let M_n be the linear space of n-square matrices with elements in some field F. For a matrix $x = (x_{ij}) \in M_n$, the permanent is defined by $\text{per}(X) = \sum_{\sigma} \prod_{i=1}^{n} x_{i\sigma(i)}$, where σ runs over all permutations of 1,2,...,n. The structure of all linear transformations T of M_n into itself such that per T(X) = per X for all $X \in M_n$ is determined. For such a permanent preserver T, and for $n \geq 3$, and with minor restrictions on F, there exist permutation matrices P Q, and diagonal matrices D, L in M_n,

such that per (DL) = 1 and either T(X) = DPXQL for all $X \in M_n$ or T(X) = DPX'QL for all $X \in M_n$, where X' denotes the transpose of X. In case n = 2, a more general type of transformation is possible. (Contractor's abstract)

153

[British Columbia U. Dept. of Mathematics] Vancouver (Canada).

ON A THEOREM OF I. SCHUR CONCERNING MATRIX TRANSFORMATIONS, by M. Marcus and F. May. [1960] [4]p. (AF 49(638)776) Unclassified

Published in Arch. der Math., v. 11: 401-404, 1960.

Theorem 1: If $2 \leq r \leq \min(m,n)$ and the r^{th} order subdeterminants of Y = T(X) are fixed linearly independent linear homogeneous functions of the r^{th} order subdeterminants of X, then there exist fixed nonsingular A and B in $M_{m,m}$ and $M_{n,n}$ respectively, such that for $m \neq n$ T(X) = AXB. If m = n then T has the form T(X) = AXB or T(X) = AX'B where X' denotes the transpose of X. This note aims to show that Theorem 1 can be made to depend on some recent general results that characterize those linear transformations of $M_{m,n}$ that map the set of rank 1 matrices into itself. Thus Theorem 1 is restated as Theorem 1': If $2 \leq r \leq \min(m,n)$ and there exists a nonsinguiar linear transformation S mapping $M_{\binom{m}{r},\binom{n}{r}}$ into itself such that for all X in $M_{m,n}$; $C_r(T(X)) = S(C_r(X))$, then there exist nonsingular A and B in $M_{m,m}$ and $M_{n,n}$ respectively such that for $m \neq n$; T(X) = AXB and for m = n, T has the form of T(X) = AXB or T(X) = AX'B. Theorem 1' is proved in a sequence of lemmas. Lemma 1: T is nonsingular. Lemma 2: There exists in $M_{\binom{m}{r},\binom{n}{r}}$ a basis of matrices of the form $C_r(X)$ for $X \in M_{m,n}$. Lemma 3: If $C_r(T(X)) = S(C_r(X))$ for all $X \in M_{m,n}$ where S is a non-singuiar linear transformation on $M_{\binom{m}{r},\binom{n}{r}}$ into itself, then there exists a nonsingular linear transformation R on $M_{\binom{m}{2},\binom{n}{2}}$ into itself such that for all $X \in M_{m,n}$; $C_2(T(X)) = R(C_2(X))$. Lemma 4: If X is of rank 1, then T(X) is of rank 1. Proof of Theorem 1' is completed by stating that any linear map T on $M_{m,n}$ into itself which maps the set of rank 1 matrices into itself must have the desired form.

154

Brown U., Providence, R. I.

SIMILARITY AND DIMENSIONAL METHODS IN MECHANICS, by L. I. Sedov, tr. by M. Friedman and ed. by M. Hoit. New York, Academic Press, 1959, 363p. incl. illus. diagrs. tables refs. (AFOSR-TR-60-32) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under [Nonr-245700]) Unclassified

Chapters included are: (I) General dimensional theory; (II) Similarity, modeling and examples of the application of dimensional analysis; (III) Application to the theory of motion of a viscous fluid and to the theory of turbulence; (IV) One-dimensional unsteady motion of a gas; and (V) Application to astrophysical problems. The first 3 chapters describe the basic ideas of the subject with illustrations from familiar problems in mechanics. The last 2 chapters show the power of dimensional and similarity methods in solving new problems in the theory of explosions and astrophysics.

155

Brown U. Dept. of Physics, Providence, R. I.

ULTRASONICALLY-INDUCED MOVEMENTS IN CELLS AND CELL MODELS, by H. Dyer and W. L. Nyborg. [1959] [2]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18-(603)54] and National Institutes of Health) Unclassified

Published in Tweifth Annual Conf. on Electrical Techniques in Med. and Biol., Digest of Technical Papers, Philadelphia, Pa. (Nov. 10-12, 1959), New York, Lewis Winner, 1959, p. 46-47.

Events occurring in plant cells and in models as a result of localized wall vibrations were discussed and illustrated in a motion picture. The models used are described. The experiments were carried out at a frequency of about 25 kc using a Cavitron magnetostrictive transducer and under controlled conditions. When the model contains a Newtonian fluid, a steady flow results, the nature of which depends on the fluid viscosity and the membrane thickness. Interesting and illuminating results involving visco-elastic behavior are obtained by filling the cell with a suitable dilute suspension which in time develops a weak gel structure. Observations obtained at various stages in the gel formation are described. (Contractor's abstract, modified)

156

Brown U. Dept. of Physics, Providence, R. I.

EFFECTS OF ACOUSTIC MICROSTREAMING AT ELECTRODES, by W. L. Nyborg and M. I. L. Seegall. [1959] [2]p. incl. diagrs. (AFOSR-TN-60-538) (Bound with its AFOSR-TR-60-70; AD 238441) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)54 and National Institutes of Health) AD 238441 Unclassified

Also published in Proc. Third Internat'l. Cong. on Acoustics, Stuttgart (Germany), 1959, Amsterdam, Elsevier Publishing Co., v. 1: 346-348, 1961.

This study was carried out with Pt-electrodes. The arrangement for generating sonically-produced microstreaming over a set of parallel Pt-wires (0.2 mm in diam) imbedded in plastic is shown schematically. The test electrode was polarized anodically relative to an ajoining one, so that O_2 was produced electrolytically at the test electrode. After a short interval the polarity was reversed by a switch. Oxygen then left the test electrode and H_2 commenced to form. The changes, referred to as cathodic depolarization, were recorded. The potential difference of reversing battery was 20 v. It was concluded that at higher amplitudes, O_2 is swept away so rapidly that its presence has no effect on the process.

157

Brown U. Dept. of Physics, Providence, R. I.

SONICALLY-INDUCED MICROSTREAMING NEAR A PLANE BOUNDARY. I. THE SONIC GENERATOR AND ASSOCIATED ACOUSTIC FIELD, by F. J. Jackson and W. L. Nyborg. [1960] 25p. incl. illus. diagrs. refs. (AFOSR-TN-60-539) (Bound with its AFOSR-TR-60-70; AD 238441) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)54 and National Institutes of Health) AD 238441 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 32: 1243-1250, Oct. 1960.

An experimental arrangement is described with permits controllable generation of small-scale acoustic streaming, i.e. "microstreaming" near a plane boundary S. This arrangement, which consists essentially of a cylindrical bar oscillating longitudinally above the boundary S in question, has been used in studies of sonically-produced effects at a fluid-solid interface. Here, it dealt with the first-order pressure and velocity fields in the thin layer of fluid between S and vibrating face of the bar. Theoretical expressions are developed, based on a simple model in which incompressible flow is assumed. Experimental determination of the pressure field was accomplished by means of a special hydrophone arrangement described herein, which measures the pressure at points along the plane boundary. The first-order theory agrees well with experiment, and is thus judged satisfactory as basis for a detailed treatment of the microstreaming flow, to be given in a subsequent paper. A byproduct of the work is a method for calibration of small hydrophones. (Contractor's abstract)

158

Brown U. Dept. of Physics, Providence, R. I.

NONLINEAR SONIC PHENOMENA, by W. L. Nyborg. Final rept. Mar. 1, 1956-Apr. 30, 1960, 1v. incl. illus. diagrs. tables, refs (AFOSR-TR-60-70) (AF 18(603)-54) AD 238441 Unclassified

A theory has been developed for a particular sonic characteristic, acoustic streaming, in terms of the equations of nonlinear acoustics. Detailed experimental investigations were made of streaming patterns under conditions of interest, and of the effects of streaming on surface processes. The phenomenon of sonically-generated microstreaming was shown to be an interesting and significant one, manifestly worthy of much further study. A number of papers published under this research project are attached and summarized.

159

Brown U. Dept. of Physics, Providence, R. I.

SONICALLY INDUCED MICROSTREAMING NEAR A PLANE BOUNDARY. II. ACOUSTIC STREAMING FIELD, by F. J. Jackson. [1960] [9]p. incl. illus. diagrs. table, refs. [AFOSR-2125] [AF 18(603)54] Unclassified

Published in Jour. Acoust. Soc. Amer., v. 32: 1387-1395, Nov. 1960.

In a previous article (see item no. 157) an experimental arrangement suitable for generating small-scale near-boundary acoustic streaming, i.e., "microstreaming," was described in a precise and controllable manner. Such microstreaming is of particular interest insofar as it can have considerable influence on processes taking place at a solid-liquid interface. In this paper, results of a comprehensive study of the microstreaming flow field associated with the aforementioned experimental system are discussed in some detail. Photographs are shown of the various flow configurations, and data are presented on streaming speeds as a function of significant experimental parameters. Theoretical expressions are developed along lines of conventional acoustic streaming theory to describe various features of the flow. The correlation between theory and experimental results is found to be good when certain criteria, described herein, are fulfilled. (Contractor's abstract)

160

Brown U. Dept. of Physics, Providence, R. I.

EFFECT OF SONICALLY INDUCED MICROSTREAMING ON THE DEVELOPMENT RATE OF A PHOTOGRAPHIC EMULSION (Abstract), by F. J. Jackson and W. L. Nyborg. [1960] [2]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)-54] and National Institutes of Health) Unclassified

Presented at Fifty-ninth meeting of the Acoust. Soc. Amer., Brown U., Providence, R. I., June 9-11, 1960.

Published in Jour. Acoust. Soc. Amer., v. 32: 933-944, July 1960.

Recent studies have indicated that the presence of small-scale acoustic streaming, or "microstreaming,"

near a solid-liquid boundary can have a considerable effect on reactions occurring at such a phase interface. Results to be discussed here represent an extension of those earlier studies with emphasis on a particular interface reaction, namely, chemical development of a photographic plate. Employing a rather simple experimental system, which permits precise and controllable generation of microstreaming in the ambient developer at the emulsion surface, it is possible to produce highly localized changes in the reaction rate. An advantage of the particular system employed is that the associated acoustic fields, both first- and second-order, recently have been studied in considerable detail. Observed photographic effects thus may be discussed readily in terms of known characteristics of these fields. By carrying out all sonic exposures at a relatively high static pressure, it has been possible in most cases to suppress completely gaseous cavitation and its associated spurious effects which often mask the orderly streaming action. Photographs of irradiated emulsions will be shown, along with densitometer recordings, illustrating the extent of reaction at various points on the emulsion. Results indicating the dependence of the reaction rate on various experimental parameters will be compared with predictions based upon features of the microstreaming.

161

Brown U. Dept. of Physics, Providence, R. I.

HEAT FLOW AND SONIC MICROSTREAMING (Abstract), by R. K. Gould and W. L. Nyborg. [1960] [1]p. [AF 18(603)54] Unclassified

Presented at Fifty-ninth meeting of the Acoust. Soc. Amer., Brown U., Providence, R. I., June 9-11, 1960.

Published in Jour. Acoust. Soc. Amer., v. 32: 933, July 1960.

Measurements are being made to determine solid-to-liquid heat flow in the presence of sonically induced microstreaming near the interface. The microstreaming is induced by an air bubble vibrating near the region of heat flow. The air bubble is placed by means of a micropipette on the bottom of a clear plastic chamber containing the liquid. A 2-kc piston vibrator operated at low amplitudes a few cm above the bubble causes the bubble to become a strong source of sonic microstreaming. Imbedded in the plastic on which the bubble sits, and concentric with the bubble, is a thin multilayered annulus, the top of which is flush with the surface of the plastic. For a typical annulus the top layer is Cu foil, the second is constantan; the bottom layer is a thermistor wafer through which current can be sent to produce a desired amount of heating. The thermal emf developed at the Cu-constantan junction can be measured. Thus a source of known heat flow and known surface temperature is obtained. Investigations have been carried out in which heat flow was measured as a function of sonic amplitude, the surface temperature of the annulus being kept constant. The results indicate that, when the sonic amplitude A is small, the heat flow H varies linearly with A. This linear relationship between H and A is in agreement with the predictions of a simplified theory. At higher amplitudes the bubble may move about erratically, so that consistent readings are difficult to obtain.

162

Brown U. [Dept. of Physics] Providence, R. I.

ULTRASONICS IN METALS AT VERY LOW TEMPERATURES, by R. W. Morse. [1959] [6]p. incl. diagrs. [AF 49(638)6] Unclassified

Published in Proc. Third Int'l. Cong. on Acoustics, Stuttgart (Germany), 1959, Amsterdam, Elsevier, v. 1: 436-441, 1961.

The nature of the research on the use of ultrasonics as a tool for learning about the electronic properties of metals is reviewed. Experimental calculations are given which enable an approximate determination of the Fermi surface in copper by ultrasonic method. The tendency of ultrasonic attenuation due to electrons to fall off very rapidly in superconductors as the temperature is lowered below T_c is illustrated with a tin single crystal. The use of the Bardeen, Cooper, Schrieffer theory as an explanation for this phenomenon is discussed.

163

Brown U. Dept. of Physics, Providence, R. I.

LATTICE THERMAL CONDUCTIVITY IN COPPER ALLOYS, by T. Olsen. [1960] [8]p. incl. diagrs. tables, refs. [AF 49(638)6] Unclassified

Published in Jour. Phys. and Chem. Solids, v. 12: 167-174, Jan. 1960.

The thermal conductivity has been measured of a series of copper-zinc alloys in the range 4·2-1·1°K, and the lattice part of the conductivity was determined. The value obtained for K_{ge} is $1{\cdot}1 \times 10^{-3}\ T^2$ W/cm-deg, which is compared with the lattice thermal conductivity that can be deduced from ultrasonic measurements in pure copper. From this it is estimated that the shear thermal modes carry about 25 times as much heat as the longitudinal one. As expected theoretically, the shear wave interaction with electrons is found to be much smaller for thermal phonons than with ultrasonic waves. The residual electrical resistance was also measured in the same copper-zinc alloys. (Contractor's abstract)

164

Brown U. Dept. of Physics, Providence, R. I.

ELECTRONIC STRUCTURE OF TIN INVESTIGATED BY ULTRASONIC ATTENUATION, by T. Olsen. [1960] [2]p. incl. diagrs. [AF 49(638)6] Unclassified

Published in Phys. Rev., v. 118: 1007-1008, May 15, 1960.

The magnetic field dependence of the ultrasonic attenuation has been measured in very pure tin single crystals. Oscillations were found that can be explained as a result of resonant conditions between the electron orbit diameter and the periodic field set up by the sound wave. These oscillations yield information about the Fermi-momentum, and the general features of a possible electron distribution in tin are suggested. (Contractor's abstract)

165

Brown U. Dept. of Physics, Providence, R. I.

FERMI SURFACES OF GOLD AND SILVER FROM ULTRASONIC ATTENUATION, by R. W. Morse, A. Myers, and C. T. Walker. [1960] [3]p. incl. diagrs. [AF 49(638)6] Unclassified

Published in Phys. Rev. Ltrs., v. 4: 605-607, June 15, 1960.

An oscillatory variation of ultrasonic attenuation in a magnetic field occurs because of geometrical coincidences between certain electron orbits and periodic electric fields accompanying sound waves. The period P in $(H\lambda)^{-1}$ is determined by the momentum p perpendicular to H and to the propagation vector k of the sound wave at those parts of the Fermi surface where this momentum is extremal, P = e/2cp. Such oscillations were observed at 4.2°K in single crystals of Au and Ag at frequencies up to 154 mc/sec. From measurements with waves propagated along various crystallographic directions, it was found that the Fermi surfaces in Au and Ag contact the Brillouin zone boundary in the [111]-direction. In Au, the size of the contact area and the shape of the "neck" joining it to the main body of the surface were obtained directly.

166

Brown U. Dept. of Physics, Providence, R. I.

THE FERMI SURFACE IN TIN FROM ULTRASONIC ATTENUATION, by T. Olsen. [1960] [8]p. incl. diagrs. [AF 49(638)6] Unclassified

Published in Proc. Internat'l. Conf. on the Fermi Surface of Metals, Cooperstown, N. Y. (Aug. 22-24, 1960), New York, Wiley and Sons, 1960, p. 237-244. (AFOSR-395)

The magnetic field dependence of the ultrasonic attenuation has been measured in very pure tin single crystals at low temperature where the electron mean free path is comparable to the acoustical wave length. The oscillatory variation of the attenuation when the field is perpendicular to the direction of sound propagation yields in a very direct way information about the Fermi surface. Both compressional waves and shear waves were propagated along four different directions in the crystal. The magnetic dependence of the attenuation and hence the Fermi momenta where found to be very anisotropic, but in general agreement with the Fermi surface suggested from the "nearly-free-electron" approximation.

167

Brown U. Dept. of Physics, Providence, R. I.

THE FERMI SURFACES OF THE NOBLE METALS BY ULTRASONICS, by R. W. Morse. [1960] [10]p. incl. diagrs. [AF 49(638)6] Unclassified

Published in Proc. Internat'l. Conf. on the Fermi Surface of Metals, Cooperstown, N. Y. (Aug. 22-24, 1960), New York, Wiley and Sons, 1960, p. 214-223. (AFOSR-395)

The shapes of the Fermi surfaces of copper, gold, and silver as revealed by ultrasonic attenuation measurements are reviewed. The experimental method employed is an oscillatory variation of attenuation with magnetic field. A variety of orbit types are found to contribute oscillatory components from which many of the characteristic dimensions of the Fermi surfaces can be calculated. It is found that all three noble metals make significant zone boundary contact in the [111] directions. For copper and gold the data give a direct measurement of the radius of the touching area, an estimate of the shape of the neck joining the zone boundary, as well as radii of the main body of the surface in several directions. (Contractor's abstract)

168

Brown U. Dept. of Physics, Providence, R. I.

ULTRASONIC ATTENUATION IN METALS, by R. W. Morse. [1960] [7]p. incl. diagrs. table. [AF 49(638)6] Unclassified

Published in Proc. Seventh Internat'l. Conf. on Low Temperature Phys., Toronto U. (Canada) (Aug. 29-Sept. 3, 1960), Toronto U. Press, 1961, p. 233-239.

A review is given of the progress in experiments on the interaction between ultrasonic waves and electrons in metals at low temperatures. Experimental problems pertaining to ultrasonic evidence of the anisotropy of the superconducting energy gap, the nature of shear wave interactions as revealed through the appearance of superconductivity, ultrasonic determination of the

Fermi surfaces of the noble metals, and the possibility of an acoustic "Faraday effect" are first discussed. Finally, the applicability of the experimental results are commented on with respect to (1) the direct measurement of the magnitude of the interaction between an elastic wave and the electrons, and (2) how the attenuation magnitude for a real metal is related to the Fermi surface and a deformation potential tensor.

169

Brown U. Div. of Applied Mathematics, Providence, R. I.

SUPERSONIC FLOW PAST FINITE DOUBLE WEDGE WINGS OF VARIABLE THICKNESS. PART I. LINEAR VARIATION, by M. Holt and B. Yim. May 1960 [35]p. incl. diagrs. (AFOSR-TN-60-431) (AF 49(638)232) AD 236725; PB 147403 Unclassified

A wing with max thickness varying linearly with span is considered. The disturbed flow field is divided into 3 regions (1) region adjacent to the forward wedge face, (2) centered expansion region above wedge shoulder, and (3) region adjacent to rear face. In (1) and (3) the additional pressure satisfies the wave equation and the velocity components are related to the pressure by simple linear 1st-order differential equations. The flow field in (2) is governed by 3 dimensional perturbed forms of the Prandtl-Meyer equations. These can be integrated numerically by the linearized method of characteristics described earlier by Holt. A still simpler numerical method determines the flow field in (3). In region (1) explicit expressions can be obtained for the additional physical quantities. It is shown that the additional pressure and velocity components vary linearly with spanwise coordinate and that all physical variables, except the spanwise velocity component, have constant values in planes normal to the leading edge. The distorted leading edge shock is therefore generated by straight lines, the slopes of which vary linearly with span. (Contractor's abstract, modified)

170

Brown U. Div. of Applied Mathematics, Providence, R. I.

SUPERSONIC FLOW PAST FINITE DOUBLE WEDGE WINGS OF VARIABLE THICKNESS. PART II. SINUSOIDAL VARIATION, by M. Holt and B. Yim. May 1960 [40]p. incl. diagrs. table. (AFOSR-TN-60-432) (AF 49(638)232) AD 236726; PB 147404 Unclassified

As in Part I (see item no. 169), a similar wing was considered, but with max thickness varying sinusoidally with span. Thus, the whole disturbed flow field also varied sinusoidally with span. In region (1) the pressure satisfies the telegraph equation and the problem of calculating the disturbed flow field reduces to an integro-differential-difference equation for the distorted shock shape function. The solution of this equation, the existence and uniqueness of which is established, is obtained in the form of series expansions in chordwise distance on the shock. The first 2 terms in this series, which converges rapidly are computed for a number of mean wedge nose angles and incident Mach numbers. Formulas giving the pressure and velocity components in terms of the shock distortion function are derived. Flow in region (2) is again determined by perturbed forms of the Prandtl-Meyer equations, but the spanwise coordinate is now absent from these, so the numerical procedure is much simpler than given in Part I. In region (3) the surface pressure satisfies a Volterra integral equation which can be solved by a simple numerical procedure. Since the edge effects were not taken into account the results apply only to a region outside the Mach cones originating at the tips of the wing leading edge.

171

Brown U. [Div. of Engineering] Providence, R. I.

ON RELATIVE MEASUREMENTS OF THE VISCOSITY OF GASES BY THE OSCILLATING-DISK METHOD, by J. Kestin, W. Leidenfrost, and C. Y. Liu. [1960] [7]p. incl. diagrs. (AFOSR-TN-60-318) [AF 18(600)891] AD 232238 Unclassified

Published in Zeitschr. Angew. Math. und Phys., v. 10: 558-564, Nov. 1959.

Available experimental observations on a thin disk oscillating, in various gases, between 2 fixed parallel plates at moderate spacings agree well with the hypothesis that the edge correction factor in the formula for torque in a smooth function of the ratio of boundary-layer thickness to separation. This allows an oscillating-disk instrument to be calibrated when it is necessary to use the intermediate spacings at which no complete theory of the instrument is yet available.

172

Brown U. Div. of Engineering, Providence, R. I.

DESIGN AND OPERATION OF AN OSCILLATING-BODY VISCOMETER FOR GASES AT HIGH PRESSURES, by J. Kestin and W. Leidenfrost. Mar. 1960 [82]p. incl. diagrs. tables, refs. (Technical rept. no. 12; rept. no. AF-891/12) (AFOSR-TN-60-375) (AF 18(600)891) AD 238993; PB 148818 Unclassified

A detailed description is given on the design and the operating experience obtained with various types of oscillating-body viscometers of high precision. Satisfactory results were obtained only with an oscillating system consisting of a flat, circular disk oscillating between 2 flat plates a small distance apart. Oscillating systems involving a free disk or a free sphere suffer from instabilities and do not yield satisfactory reproducibility. Oscillating systems involving concentric spheres with small gaps suffer from a large systematic error whose origin was not fully explored. (Contractor's abstract)

173

Brown U. Div. of Engineering, Providence, R. I.

[MEASUREMENT OF VISCOSITY OF GASES AT HIGH PRESSURES AND VARYING TEMPERATURES BY THE OSCILLATING DISK METHOD] by J. Kestin. Final rept. Mar. 1960, 6p. incl. refs. (Technical rept. no. 13; rept. no. AF-691/13) (AFOSR-TR-60-53) (AF 16(600)691) AD 238994; PB 148619 Unclassified

A new analytic theory was developed for the oscillating disk type viscosimeter. Other shapes, in particular spheres, were proved to be feasible. Two viscosimeters were designed and built, one for work at moderate pressures and room temperature, and one for higher temperatures (up to 300°C). Both proved successful and were highly accurate. Data were collected on the viscosity of about 15 gases and one system of mixtures (N_2-CO_2).

174

Brown U. [Div. of Engineering] Providence, R. I.

THE VISCOSITY OF SUPERHEATED STEAM UP TO 270°C, by J. Kestin and H. E. Wang. [1960] [19]p. incl. diagrs. tables, refs. [AF 16(600)891] Unclassified

Published in Physica, v. 26: 575-584, Aug. 1960.

A series of measurements on the viscosity of superheated steam obtained with the aid of an oscillating-disk viscometer are described. Measurements were made along the following 4 approximate isotherms: 136°C, 166°C, 196°C and 234°C, from about atmospheric to saturation pressure. It is considered that the results are accurate to ±0.5%. The measurements show excellent agreement with an earlier series obtained by J. R. Moszynski and the combined results were used to provide a tabulation for superheated steam up to 270°C. The extrapolated results for 1 atm show good agreement with the recent measurements by A. S. Shifrin. The present results reveal an anomaly in that the pressure coefficient of viscosity is negative, decreasing with increasing temperature down to zero at 270°C. (Contractor's abstract)

175

Brown U. Div. of Engineering, Providence, R. I.

HEAT TRANSFER FROM SURFACES OF NON-UNIFORM TEMPERATURE DISTRIBUTION. PART II. TURBULENT TRANSFER FROM ISOTHERMAL SPANWISE STRIPS ON A FLAT PLATE, by H. H. Sogin and R. J. Goldstein. Feb. 1960 [46]p. incl. diagrs. tables, refs. (AFOSR-TN-60-647) (AF 49(638)46) AD 240223; PB 149454 Unclassified

Experiments were performed on the mass transfer by forced convection from naphthalene strips on a flat plate to an air stream at ordinary temperature and pressure. Turbulence was induced in the boundary layer by means of a wire trip. In all cases there was a hydrodynamic starting length upstream of the strips. The ratio of this inert length to the total length was varied from about 0.60 to 0.96. The flow was practically incompressible with Reynolds number, based on the total length, varying from 175,000 to 466,000. The Schmidt number was 2.5. The experimental results fall in proximity to the Seban step function factor when they are reduced after the mass-momentum analysis of Deissler and Loefiler for a surface of uniform vapor pressure. When Karman's formulation of the mass-momentum analogy is assumed, the data fall between the values predicted by the Seban and by the Rubesin expression for the step function factor. The results are well correlated by the Colburn analogy in conjunction with the Rubesin step function factor. (Contractor's abstract)

176

Brown U. Div. of Engineering, Providence, R. I.

HEAT TRANSFER FROM SURFACES ON NON-UNIFORM TEMPERATURE DISTRIBUTION. FINAL REPORT - PART I. LOCAL RATES OF MASS TRANSFER FROM CYLINDERS IN CROSS FLOW, by H. H. Sogin, V. S. Subramanian, and R. J. Sogin. July 1960 [74]p. incl. diagrs. tables, refs. (AFOSR-TR-60-76, Pt. 1) (AF 49(638)46) AD 240629; PB 149597 Unclassified

Also published in Jour. Heat Transfer, v. 83: 483-493, Nov. 1961.

The distribution of the local rate of mass transfer from 4.2-in.-diam naphthalene cylinders to air flowing normal to the axis was investigated. The air speeds, ranging from 56-166 ft/sec are in the critical zone. The temperatures ranged from 73.6 - 84.7°F. The results in the laminar region was compared with predictions based on the approximate boundary-layer calculations of H. Schuh (Stockholm Technisk Hogskolan Flygtekniska Inst., Tech. Note 32, 1959) and of H. J. Merk (Jour. Fluid Mech., v. 5: 460, 1959). Also, the results were compared with the heat transfer measurements of Schmidt and Wenner (NACA TM 1050, 1943) and of Zapp ("The effect of turbulence on local heat transfer coefficients around a cylinder to an air stream", M. S. thesis, Oregon State Coll., 1950), and the mass transfer measurements of Winding and Cheney (Indus. and Eng. Chem., v. 40: 1067, 1946). The effect of changing the turbulence intensity of the main stream from 0.8 - 2.4% by means of a wire grid is also presented. (Contractor's abstract, modified)

177

Brown U. Div. of Engineering, Providence, R. I.

HEAT TRANSFER FROM SURFACES OF NON-UNIFORM

TEMPERATURE DISTRIBUTION. FINAL REPORT - PART II. LOCAL SUBLIMATION FROM DISKS IN AXISYMMETRIC FLOW, by E. H. Sogin and V. Oskay. July 1960 [47]p. incl. diagrs. tables, refs. (AFOSR-TR-60-78, Pt. 2) (AF 49(638)46) AD 240638; PB 149598 Unclassified

The radial distribution of the local rate of mass transfer was measured on 4-in. naphthalene disks facing air streams in axisymmetric flow. The air speeds range from 71 - 128 ft/sec, and the temperature from 75 - 90°F. The results were compared with the solution by Merk (Jour. Fluid Mech., v. 5: 460, 1959). The effect of a change in turbulence intensity from 0.8 - 2.4% is included. Experimental results on disks with inert central regions were also compared with a wedge-type step function factor. (Contractor's abstract)

178

Brown U. Div. of Engineering, Providence, R. I.

LAMINAR TRANSFER FROM ISOTHERMAL SPANWISE STRIPS ON A FLAT PLATE, by H. H. Sogin. [1960] [11]p. incl. diagrs. refs. (AF 49(638)46) Unclassified

Presented at the ASME-AIChE Heat Transfer Conf., Storrs, Conn., Aug. 9-12, 1959.

Published in Jour. Heat Transfer, v. 82: 53-63, Feb. 1960.

The Rubesin-Klein-Tribus method is used to calculate rates of heat transfer by forced convection from 2 isothermal spanwise strips in tandem. The general results are applicable to either laminar or turbulent flow. Predictions of laminar transfer are based on Eckert's step function. In experimentation, naphthalene cast in trays is used to simulate the isothermal strips while the inert material between them simulates the adiabatic wall. The velocities range from about 40 - 90 ft/sec, and the air temperature from 72 - 88°F. The boundary layer is shown to be laminar. The theoretical and experimental results are found to be in good agreement, confirming the calculation method and Eckert's step function. The experimentation is extended to an array of several equally spaced strips in tandem. Effects of roughness and spanwise diffusion are noted. (Contractor's abstract)

179

Brown U. Div. of Engineering, Providence, R. I.

ON TRANSONIC FLOW ABOUT TWO PARALLEL BODIES OF REVOLUTION, by E. J. Softley. May 1960 [63]p. incl. diagrs. (Technical rept. WT-33) (AFOSR-TN-60-706) (AF 49(638)444) AD 244243 Unclassified

Potential theory, based on linearization of the transonic flow equation, is applied to the case of 2 slender bodies of revolution, situated with parallel axes and within a region where interference effects cannot be neglected. The forces on the bodies are discussed and as an example the drag of 1 body is computed and compared with experimental results obtained by G. Drougge.

180

Brown U. Div. of Engineering, Providence, R. I.

LINEARIZED TRANSONIC FLOW ABOUT SLENDER BODIES AT ZERO ANGLE OF ATTACK, by P. F. Maeder and H. U. Thommen. Oct. 1960 [39]p. incl. diagrs. refs. (Technical rept. no. WT-34) (AFOSR-TN-60-1247) (AF 49(638)444) AD 248228; PB 153644 Unclassified

The simple linearized transonic flow theory as originally proposed by Oswatitsch and Keune (Proc. of Conf. on High-Speed Aeronautics, Polytechnic Inst. of Brooklyn, 1955) and by the present authors (Jour. Aeronaut. Sci., v. 23: 187, Feb. 1956) is improved by considering and partially correcting its error. In this manner a theory which is easy to apply and which should be valid for a great number of smooth bodies is obtained. This improved theory predicts shock waves in the lower transonic regime. It is applied to a number of significant body and airfoil shapes and its predictions are compared with experiments and results of other theoretical investigations. (Contractor's abstract)

181

Brown U. [Div. of Engineering] Providence, R. I.

TRANSONIC AND SUPERSONIC FLOW, by P. F. Maeder. Final rept. Nov. 3, 1960, 4p. (AFOSR-TR-60-164) (AF 49(638)444) Unclassified

The report is summarized in the following 4 phases: (1) Hot wire anemometry: The redesigned transistorized anemometer is a considerable improvement over the original vacuum-tube unit, and should meet all the specifications which were originally determined as necessary for the separation of the variables in turbulent flow. Its performance is excellent and operation is simple. (2) Hypersonic aerodynamics: The design of the hypersonic facility was constructed and successfully tested. (3) Transonic aerodynamics: The work on linearized transonic theory was completed and the results are presented in 2 reports (see item nos. 179 and 180, Vol. IV). (4) Drag reduction in supersonic flow: The results given in 3 reports are summarized (item nos. 119, 120, and 121, Vol. III).

182

Brown U. Metals Research Lab., Providence, R. I.

RADIATION EFFECTS INVOLVING THE (n,α)

REACTION IN GLASS CONTAINING BORON, by R. Truell and C. Mylonas. Oct. 1, 1960 [35]p. incl. diagrs. table. (AFOSR-TR-60-160) (AF 49(638)450)
AD 247031 Unclassified

The damage effects induced by slow neutron reactions with B_5^{10} in 7070 glass was examined by means of measuring the changes in the physical dimensions, photoelastic measurements, and ultrasonic methods. The sample lengths obtained as a function of irradiation time or flux showed that although there were large changes in dimensions as the result of annealing, the irradiation changes were apparently independent of the annealing changes. The curve of length contraction as a function of irradiation flux was not linear. Photoelastic determination of optical-stress characteristics was carried out with higher precision than previously. Ultrasonic attenuation and velocity measurements are valuable in annealing experiments but they are not yet useful for "in reactor" study of damage with this material. (Contractor's abstract, modified)

183

Brown U. [Metcalf Research Lab.] Providence, R. I.

[STATISTICAL MECHANICAL THEORY OF IRREVERSIBLE PROCESSES] by J. Ross. Final rept. 1956-1960. Nov. 1960, 13p. (AFOSR-TR-60-180) (AF 18(603)87)
AD 249039 Unclassified

Summaries of research results are given on (1) a derivation of the Boltzmann equation for quantum gases at low density; (2) the application of the correlation function method (fluctuation dissipation theory) for the treatment of transport processes and chemical kinetics; (3) the derivation of the quantum corrections for transport coefficients; and (4) a review paper on topics in quantum statistics pertaining to the Wigner function, scattering theory, construction of ensembles for equilibrium and non-equilibrium systems, the Boltzmann equation, and the correlation function method. (Contractor's abstract, modified)

184

Brown U. [Metcalf Research Lab.] Providence, R. I.

QUANTUM CORRECTIONS FOR TRANSPORT COEFFICIENTS, by S.-I. Choi and J. Ross. [1960] [8]p. incl. diagrs. [AF 18(603)87] Unclassified

Published in Jour. Chem. Phys., v. 33: 1324-1331, Nov. 1960.

The equation of motion of a quantum-mechanical 2-particle system is solved without approximation in an expansion in Planck's constant. First-order quantum corrections comprising all contributions to the coefficient of $\hbar^2$ in the expansion are derived for the differential scattering cross section and the kinetic-theory transport coefficients. Numerical results are obtained for a simple model of molecular interactions, and lack of agreement is found with work based on the WKB solution of the Schrödinger equation. (Contractor's abstract)

185

Brown U. Metcalf Research Lab., Providence, R. I.

DIELECTRIC RELAXATION OF ISOAMYL BROMIDE, by S. H. Glarum. [1960] [5]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1451) [AF 49(638)31] Unclassified

Published in Jour. Chem. Phys., v. 33: 639-643, Sept. 1960.

The complex dielectric constant of isoamyl bromide has been measured at 1, 3, and 9 kmc between -75° and 25°C. Complex plane plots indicate an asymmetric, skewed-arc distribution of relaxation times, with the shape of the distribution function not being appreciably temperature dependent. A defect diffusion model is proposed to explain the dielectric behavior of this system. This model implies that the relaxation of a molecule is more probable immediately after one of its neighbors has relaxed than at an arbitrary time. A distribution of relaxation times is derived which, under the appropriate conditions, closely resembles that of the empirical skewed-arc function. (Contractor's abstract)

186

[Brown U. Metcalf Research Lab., Providence, R. I.]

[THEORY OF DIELECTRIC RELAXATION, by S. H. Glarum] [1960] [13]p. incl. tables, refs. (AFOSR-TN-60-1452) [AF 49(638)31] Unclassified

Dielectric measurements in the frequency range of 45 cs-400 kcs at temperatures between -55°C and -25°C are reported for polypropylene glycols (PPG) of mol-wt 1000-4000 and for polybutylene glycols (PBG) of mol-wt 500-2000. Some measurements of the PPG in methyl cyclopentane solution are also reported. Two absorption regions were found; the secondary absorption at low frequency is dependent on the mol-wt and has been assigned to a small 'head to tail' moment while the primary absorption at higher frequency is found to be asymmetric in a novel fashion. This absorption is assigned to the orientation of the $-CH_2OCH_2-$ linkage and its asymmetry has been discussed in the light of the recent defect diffusion theory of Glarum. Values of ΔH, ΔS, and ΔF have been evaluated for the primary absorption in both series of glycols and a comparison has been made between these values and those obtained for the elastic deformation process in some solid elastic polymers. (Contractor's abstract)

187

Brown U. [Metcalf Research Lab.] Providence, R. I.

CHEMICAL REACTIONS IN SHOCK WAVES (Abstract), by E. F. Greene. [1960] [2]p. (AF 49(638)167) Unclassified

Presented at First AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, General Dynamics Corp. General Atomic Div., San Diego, Calif., Sept. 6-7, 1960. (AFOSR-TN-60-1063; AD 246174)

The results of 3 of the projects are given as follows: (1) The ionization reaction in Ar, Kr, and Xe was examined by observing the variation with time and wavelength of the line and continuum emission behind reflected shock waves. It is shown that the gas reaches an equilibrium degree of ionization in the observation time; the electron temperature can be measured; and the continuum emission is due to electron-ion recombination. The recombination cross section is very nearly the same for all 3 gases and agrees with the value predicted by a simple theory. (2) The kinetics and mechanism of the reactions occurring when a mixture of Ar and BrCN is heated in an incident shock to temperatures of 2500-5500°K are studied. The intensity of the band emission from CN and C_2 and the continuous background with time are measured. The decomposition of BrCN is 1st-order in Ar and BrCN and has an activation energy equal to the bond energy of Br-C. The CN radical then reacts further (1st-order in Ar, 1st- or half-order in CN, activation energy 175 kcal/mol to form C_2 and presumably N_2. The formation of C_2 is probably 3/2 order in CN and zero order in Ar. (3) The validity of the normal mechanism for the $H_2 + Br_2$ reaction at temperatures up to 2500°K is tested. The Br_2 concentration is followed by absorption. Some success is obtained in measuring the Br-atom concentration by following the emitted light. The normal mechanism seems to remain valid within the experimental accuracy, although the steady state hypothesis for Br breaks down. Plans for future studies are: (a) The relative rates of dissociation and vibrational relaxation in HCl are to be studied by observing the shift towards the visible of the UV absorption edge as higher vibrational states become populated. (b) One is to obtain a suitable test of the reflected shock wave for more precise kinetic studies by allowing for the distortions of one dimensional flow, due to the boundary layers, by means of an extrapolation to infinite tube diameter. The other is a study of the quick cooling of a reflected shock wave by the reflection of a rarefaction wave from the contact surface back into the hot gas. It is hoped to apply this quick cooling, combined with an analysis of the stable products left behind, to study some unimolecular reactions at higher temperatures than those normally used. (Contractor's abstract, modified)

Brussels U. (Belgium) <u>see</u> Free U. of Brussels (Belgium)

188

Bryn Mawr Coll. Dept. of Psychology, Pa.

BODY SPACE: TACTILE-KINESTHETIC SCHEMA, by R. S. Davidon. Sept. 30, 1960 [11]p. (Technical note no. 1) (AFOSR-TN-60-1355) (AF 49(638)726) AD 247473 Unclassified

This is the 1st of a series of psychophysical studies to define tactile-kinesthetic spatial relationships within and around the body for normal subjects. The apparatus and methods used to carry out quantitative determinations from 4 subjects are described. Preliminary results indicate that the relation of phenomenal to physical distance is different on opposite sides of the body; influenced by the position of the limbs; not linear; and not the same for each dimension for the arm.

189

Burden Neurological Inst. [Physiological Dept.] Bristol (Gt. Brit.).

SPATIAL AND TEMPORAL CHARACTERISTICS OF THE ALPHA RHYTHM: A TOPOSCOPIC ANALYSIS, by R. Cooper and A. C. Mundy-Castle. [1960] [13]p. incl. illus. diagrs. table, refs. (AFOSR-TN-60-739) (AF 61(514)1178) AD 239467 Unclassified

During a number of experiments with the helical scan toposcope, certain characteristic features were noted concerning the spatial and temporal distribution of the alpha rhythm. In particular, two main categories of anteroposterior, spatio-temporal distribution were distinguished, one in which the instant of maximal amplitude of alpha waves became progressively later or earlier according to the proximity of the recording electrodes to the occiput, the other in which maximal amplitude occurred simultaneously in all channels, usually with a change of sign over the occipital areas. Exact interhemispheric synchrony was rare. These and several subsidiary features of the alpha rhythm were discussed, and a number of hypotheses put forward in an attempt to provide an overall explanatory theory concerning the nature and generation of the alpha rhythm. (Contractor's abstract)

190

Burden Neurological Inst. Physiological Dept., Bristol (Gt. Brit.).

ADOLF MEYER RESEARCH LECTURE. WHERE VITAL THINGS HAPPEN, by W. G. Walter. [1960] [34]p. incl. illus. diagrs. (AFOSR-TN-60-741) (AF 61(514)-1178) AD 239468 Unclassified

Presented at 115th annual meeting of the Amer. Psychiatric Assoc., Philadelphia, Pa., Apr. 27-May 1, 1959.

Published in Amer. Jour. Psychiat., v. 116: 673-694, Feb. 1960.

The principle of mental physiology is discussed with respect to the complexity of the central nervous system. From a physiologist's point of view, the first process is referred to as the identification of operational parameters in order to carry out psychobiological research by experiments and analyses. These parameters are versatility, imagery, stability and ductility. They are means to systematize the obtained observations of changes in human brains and bodies during experimental tests of function. Experiments on human conditioning were carried out with 5 subjects. The test procedures are described. The obtained histogram plots of GSR latencies of these selected normal subjects and patients are analyzed. It is concluded that there are at least 3 basic functional sub-categories or modes of central nervous action related to mental action, all involved with and depending on the basic neuro-humoral operations of the autonomic system. The categories are: (1) the unconditional responses to specific stimuli; and (2) the selective sorting of consecutive or related events so as to construct within the nervous system a working model of the outer world with enough detail and accuracy to permit coherent and relevant actions of control.

191

Burden Neurological Inst. [Physiological Dept.] Bristol (Gt. Brit.).

A STATISTICAL APPROACH TO THE THEORY OF CONDITIONING, by W. G. Walter. [1960] [15]p. incl. diagrs. (AFOSR-3760) (AF 61)514)1178) Unclassified

Presented at Moscow Colloquium on Electroencephalography of Higher Nervous Activity, Moscow (U.S.S.R.), 1960.

Also published in Electroencephalog. and Clin. Neurophysiol. Jour., Suppl. 13: 377-391, 1960.

A theory which postulates that higher nervous function as evidenced by the formation of conditioned reflexes may be considered as embodying mechanisms for the computation of contingency or conditional probability is investigated on the basis of a statistical approach. The variations in autonomic and somatic function are primarily temperamental rather than conditional and individual variation is a prime factor in the interpretation of the physiologic events associated with conditioning. Versatility seems to be connected with the variations and responsiveness of the alpha rhythms which indicate the mobility and repertoire of the visual association mechanisms. It is also pointed out that balance seems to be associated with cortico-autonomic stability rather than with mere excitatory-inhibitory equilibrium. The parameter of strength may correspond inversely with ductility associated with the relative abundance of delta activity.

192

Burden Neurological Inst. Physiological Dept., Bristol (Gt. Brit.).

CONDITIONING THEORIES AND THEIR THERAPEUTIC APPLICATIONS, by W. G. Walter. [1960] [9]p. incl. illus. diagrs. refs. [AF 61(514)1178]

Unclassified

Published in Proc. Roy. Soc. Med., v. 53: 495-503, July 1960.

How hypoxia and CO_2 administration affect the establishment and maintenance of a variety of conditioned reflexes in 5 dogs have been studied. The experimental results are able to give practical introduction to the Pavlovian typology or the three "operational parameters", namely strength, balance, and versatility. The geometrical form of these parameters is discussed. As to the application of this hypothesis of conditioning to human, it is illustrated by studies made on 3 subjects (1 normal and 2 patients). Their conditioning curves and PGR latencies (before, during, and after treatment in the case with the patients) are compared and discussed statistically. It is concluded that this type of treatment is opening a new approach to mental therapy.

193

Bureau of Mines, Bartlesville, Okla.

INFRARED SPECTRA OF ORGANIC COMPOUNDS IN THE REGION 15-35 MICRONS: THIRTEEN ORGANIC OXYGEN, NITROGEN, SULFUR, AND SILICON COMPOUNDS, by C. A. Frenzel, D. W. Scott, and J. P. McCullough. Nov. 1960 [16]p. incl. diagrs. (AFOSR-TN-60-1221) (CSO-680-59-9) AD 246090

Unclassified

The spectra of tetrahydrofuran, 1-methylpyrrole, piperidine, 2-methylpyridine, 3-methylpyridine, 2-propanethiol, cyclopentanethiol, 2-methyl-2-butanethiol, 3,3-dimethyl-2-thiabutane, cyclohexanethiol, cyclopentyl-1-thiaethane, 2,4-dimethyl-3-thiapentane, and hexamethyldisiloxane are given. The spectrometer used was a Perkin-Elmer Model 112 with an ac thermocouple signal fed through a Model 81, 13-cycle amplifier to a Brown Electronik strip-chart potentiometer. Each spectrum contained full information about the source and purity of the samples and the conditions of the measurements. Numerical values of the wavelengths and frequencies of the infrared absorption maxima are also given.

194

Bureau of Mines, Bartlesville, Okla.

HEXAMETHYLDISILOXANE: CHEMICAL THERMODYNAMIC PROPERTIES AND INTERNAL ROTATION ABOUT THE SILOXANE LINKAGE, by D. W. Scott, J. F. Messerly and others. [1960] [7]p. incl. tables, refs. (AFOSR-TN-60-1396) (CSO-680-59-9) AD 249544 Unclassified

Published in Jour. Phys. Chem., v. 65: 1320-1326, Aug. 1961.

Thermodynamic, spectroscopic, and molecular structure information was used to show that internal rotation about an Si-O bond in hexamethyldisiloxane is free or nearly so. Thermodynamic functions for hexamethyldisiloxane in the ideal gas state (0-1500°K) were calculated by methods of statistical mechanics. Experimental studies provided the following information: values of heat capacity for the solid (11°K to the triple point), the liquid (triple point to 375°K) and the vapor (363-500°K); the triple point temperature; the heat of fusion; thermodynamic functions for the solid and liquid (0-375°K); heat of vaporization (332-374°K); parameters of the equation of state; and vapor pressure (309-412°K). Thermodynamic functions also were calculated for the related substance tetramethylsilane. (Contractor's abstract)

195

Bureau of Mines, Bartlesville, Okla.

A NEW APPROACH TO THE COMBUSTION CALORIMETRY OF ORGANOSILICON COMPOUNDS. THE HEATS OF COMBUSTION AND FORMATION OF HEXAMETHYLDISILOXANE, by W. D. Good, J. L. Lacina, and J. P. McCullough. Nov. 1960, 14p. incl. tables, refs. (AFOSR-TN-60-1414) (CSO-680-59-9) AD 249545; PB 171508 Unclassified

A rotating-bomb method was developed for the precision combustion calorimetry of organosilicon compounds. The standard heat of combustion of hexamethyldisiloxane was determined, and a tentative value of the heat of formation was derived. An experimental method was found that may ultimately lead to improved values of the heat of formation of aqueous fluosilicic acid solutions. More reliable values of the heats of combustion and formation of benzotrifluoride were determined. (Contractor's abstract)

196

Bureau of Mines, Bartlesville, Okla.

TRIMETHYLALUMINUM: THERMODYNAMIC FUNCTIONS IN THE SOLID AND LIQUID STATES, 0-380°K; VAPOR PRESSURE, HEAT OF VAPORIZATION, AND ENTROPY IN THE IDEAL GAS STATE, by J. P. McCullough. Feb. 1961, 10p. incl. tables, refs. (AFOSR-TN-60-1477) (CSO-680-59-9) AD 251623 Unclassified

Also published in Jour. Phys. Chem., v. 67: 677-679, Mar. 1963.

The thermodynamic properties of selected organic derivatives of elements in the second and third rows of the periodic table were studied by means of low temperature calorimetry and comparative ebulliometry. The following properties of trimethylaluminum were determined: thermodynamic functions in the solid and liquid states (0-380°K); vapor pressure (336-400°K); heat of vaporization (298.15°K); and entropy in the ideal gas state (298.15°K). If the results are feasible, they are to be used with spectroscopic and molecular structure data in order to calculate chemical thermodynamic functions in the ideal gas state in the range of 0-1500°K, and in evaluating thermochemical bond energies.

197

[Bureau of Mines, Pittsburgh, Pa.]

TURBULENT BURNING VELOCITIES OF CORE-ZONE FLAMES, by J. K. Richmond, J. Grumer, and D. S. Burgess. [1960] [9]p. incl. diagrs. tables, refs. [AFOSR-2496] (CSO-680-58-10) Unclassified

Also published in Eighth Symposium (Internat'l.) on Combustion, California Inst. of Tech., Pasadena (Aug. 28-Sept. 3, 1960), Baltimore, Williams and Wilkins Co., 1962, p. 534-542. (AFOSR-TR-60-127)

A procedure for estimating turbulent velocities in some Bunsen-type flames is described. This method is based on the reasonable assumption that the average flame outline is a simple paraboloid of revolution. Values calculated by this method agree with the empirical equation of Bollinger and Williams, $S_T = 0.18\, S_L d^{0.26} Re^{0.24}$. The relationship is thought to apply to all flames in the turbulent core of the approach stream but not to flames in the wake of the burner tube. At large burner diameters (about 3 in. for natural gas-air) the sharp distinction between core and wake flames disappears. On a purely empirical basis, the Bollinger and Williams law is shown to conform to the Damkohler-Schelkin equation, $S_T = S_L (\epsilon + K)/K^{\frac{1}{2}}$, proposed for flames with fine-scale turbulence. However, it is argued that core flames are not fine-scale in the sense of the Damkohler and Schelkin postulates. (Contractor's abstract)

198

California Inst. of Tech., Pasadena.

ORGANIC REACTION MECHANISM, by R. E. Pincock and G. S. Hammond. Final rept. [1960] [10]p. incl. diagrs. tables. (AFOSR-TR-60-122) (AF 49(638)696) AD 623089 Unclassified

This report summarizes some of the more promising work concerned with reactions of tetraphenyltetrazene, paramagnetic catalysis, and preparation of t-butyl-peroxyformate. It is shown that since the decomposition of tetrazene follows first order kinetics and is insensitive to the presence of acetic acid, the initial step is strictly thermal cleavage of the nitrogen-nitrogen bonds. The two stabilized diphenylamine radicals then dimerize by coupling at nitrogen to form hydrazine or by carbon-nitrogen coupling to form the yellow azine and other colored products. The effect of FeDPM on a number of reactions was tested to ascertain if various thermal reactions in organic chemistry involve a triplet state as an intermediate. The paramagnetic substance shows no effects on anthracene, but does increase the decomposition of ethyl phenylglyoxalate and ethyl pyruvate. It is also shown that the perester t-butyl-peroxyformate decomposes by first-order kinetics and has a half-life at 138.7° of 87 min.

199

California Inst. of Tech. Antenna Lab., Pasadena.

ON THE INDEX OF REFRACTION OF SPATIALLY PERIODIC PLASMA, by C. H. Papas. Jan. 1961, 5p. (Technical rept. no. 25) (AFOSR-82) (AF 18(600)1113) AD 251880; PB 155034 Unclassified

Also published in Fourth Internat'l. Conf. on Ionization Phenomena in Gases, Uppsala, Sweden (Aug. 17-21, 1959), Amsterdam, North-Holland Publishing Co., 1960, p. 718-720.

A knowledge of the change produced in the index of refraction of a uniform plasma by the spontaneous generation of coagula or inhomogeneities is essential to the use of electromagnetic waves as a diagnostic tool. The general problem is a difficult one to handle, but certain non-trivial cases are mathematically tractable. One of these, which is also of some practical import, occurs when the inhomogeneities are periodically distributed throughout the plasma. Here this special case is analyzed within the framework of the theory of periodic structures. The problem is reduced by virtue of Floquet's theorem to an equivalent problem for the domain of a unit cell with periodic boundary conditions. An approximate solution is obtained by a simplified theory. As a specific application the calculation for a plasma with periodically spaced spherical inhomogeneities is worked out in detail. (Contractor's abstract)

200

California Inst. of Tech. Guggenheim Aeronautical Lab., Pasadena.

A SUMMARY OF THE THEORIES AND EXPERIMENTS ON PANEL FLUTTER, by Y. C. B. Fung. May 1960, 76p. incl. diagrs. tables, refs. (AFOSR-TN-60-224) (AF 49(638)220) AD 240284; PB 149764 Unclassified

In recent years a sizable literature has grown out of the field of panel flutter. Much effort was spent in resolving several theoretical difficulties which arise one way or another when an analytical problem is simplified by introducing various limiting cases and approximations. These difficulties are now fairly well understood. In the meantime, a considerable amount of numerical evaluation has been done so that the technical significance of the problem can be better appreciated. The present article gives a review of various theories, and a summary of the panel-thickness requirements for the prevention of flutter under various circumstances. At the present time, available information on supersonic panel flutter is still incomplete. It is hoped that the present article may provide a guide to the existing literature; and, in projecting the known areas in clear relief, may serve to suggest areas for future research. (Contractor's abstract)

201

California Inst. of Tech. Guggenheim Aeronautical Lab., Pasadena.

STOKES FLOW OF A CONDUCTING FLUID PAST AN AXIALLY SYMMETRIC BODY IN THE PRESENCE OF A UNIFORM MAGNETIC FIELD, by L.-D. Chang. [1960] [5]p. (AFOSR-61) (AF 49(638)521) AD 250176 Unclassified

Also published in Jour. Fluid Mech., v. 9: 473-477, Nov. 1960.

Low Reynolds number flow of an incompressible fluid past an axially symmetric body in the presence of a uniform magnetic field is studied using a perturbation method. It is found that for small Hartmann number M an approximate drag formula is given by $D' = D'_0(1 + \frac{D'_0}{16\pi\rho\nu aU}M) + O(M^2)$, where D'_0 is the Stokes drag for flow with no magnetic effect. (Contractor's abstract)

202

California Inst. of Tech. Guggenheim Aeronautical Lab., Pasadena.

ON THE WALL EFFECT CORRECTION OF THE STOKES DRAG FORMULA FOR AXIALLY SYMMETRIC BODIES MOVING INSIDE A CYLINDRICAL TUBE, by

L.-D. Chang. [1960] [9]p. incl. table. (AFOSR-527) (AF 49(638)521) AD 257211 Unclassified

Also published in Zeitschr. Angew. Math. und Phys., v. 12: 6-14, 1961.

The author considers the problem of the motion of an axially symmetric body at constant velocity U along the axis of a tube filled with viscous fluid. The following approximate expression is obtained for the drag D under the assumption that the dimensions of the body are small compared to the radius R of the tube: $D = D_0(1 + \frac{\varkappa D_0}{2\pi^2 \mu UR})$. Here D_0 is the drag due to motion at constant velocity U in an infinite fluid, $\varkappa$ is a constant approximately equal to 2.203, and μ is the viscosity constant. (Math. Rev. abstract)

203

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

SHOCK TUBE MEASUREMENTS OF THE f-NUMBER FOR THE (0,0)-BAND OF THE OH $^2\Sigma - ^2\Pi$ TRANSITIONS, by M. Lapp. May 1960, 44p. incl. illus. diagrs. refs. (Technical note no. 11) (AFOSR-TN-60-666) (AF 18(603)2) AD 239582 Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 1: 30-45, Sept. 1961.

The f-number for the (0,0)-band of the $^2\Sigma - ^2\Pi$ transitions of OH was found to be $(0.9 \pm 0.5) \times 10^{-3}$. A shock tube was used to produce hot gas samples at temperatures from 3300 to 3900°K with equilibrium partial pressures of OH of 0.004 to 0.02 atm. The emission intensities were measured photoelectrically as a function of time behind the reflected shock in a selected spectral interval. These results were then related to the f-number by means of an absolute intensity calibration. (Contractor's abstract)

204

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

SHOCK-TUBE MEASUREMENTS OF THE HOMOGENEOUS RATE OF DECOMPOSITION OF NH_3 IN NH_3-AR MIXTURES, by T. A. Jacobs. May 1960, 11p. incl. diagrs. refs. (Technical note no. 12) (AFOSR-TN-60-667) (AF 18(603)2) AD 239584 Unclassified

Also published in Eighth Symposium (Internat'l.) on Combustion, California Inst. of Tech., Pasadena (Aug. 28-Sept. 3, 1960), Baltimore, Williams and Wilkins Co., 1962, p. 151-154. (AFOSR-TR-60-127)

The results of preliminary activation energy measurements using infrared emission for the decomposition of NH_3 are presented. The experiment is based on the assumption that if radiation is attained in times short compared with the chemical decomposition times after passage of the shock wave and, furthermore, that if the NH_3 behaves as a transparent gas, it is then possible to measure the change in NH_3 concentration directly by following the infrared emission intensity as a function of time. It is assumed that the initial step in the homogeneous decomposition is $NH_3 + M \rightarrow NH_2 + H + M$ where M is either Ar or NH_3. The measured activation energy is 52 kcal which is low. It is explained that this is probably a measurement of the early rate and a chain reaction is a reasonable explanation of this low activation energy measurement.

205

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

VIBRATIONAL RELAXATION IN CYLINDRICAL CHAMBERS CONTAINING ISOTHERMAL, DILUTE GAS MIXTURES, by S. S. Penner, D. [B.] Olfe, and T. A. Jacobs. May 1960, 13p. (Technical note no. 13) (AFOSR-TN-60-668) (AF 18(603)2 AD 239585 Unclassified

Vibrational excitation is considered in the presence of an external radiation field and deexcitation in the absence of the field for stationary, dilute systems in cylindrical containers in which surface deactivation of excited species is so effective as to reduce the concentration of vibrationally excited molecules to zero at the bounding surfaces. The maximum fraction of vibrationally excited molecules is presumed to be sufficiently small to permit the approximation that the system remains isothermal at the temperature T and at constant pressure p and density ρ. The rate of excitation is examined in an external radiation field and the subsequent rate of deexcitation when the external radiation field is removed. The external radiation field is assumed to be of such high intensity compared with thermal radiation in the system that the latter may be considered to be negligibly small. Internal reflection and scattering are neglected. (Contractor's abstract, modified)

206

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

EQUILIBRIUM EMISSIVITY CALCULATIONS FOR A HYDROGEN PLASMA AT TEMPERATURES UP TO 10,000°K, by D. [B.] Olfe. May 1960, 67p. incl. diagrs. tables, refs. (Technical rept. no. 14) (AFOSR-TN-60-669) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)2 and Office of Naval Research under Nonr-22003) AD 239405 Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 1: 104-134, Nov. 1961.

The important equilibrium emission processes in a hydrogen plasma were investigated in the temperature range between 300°K and 10,000°K for pressures up to several hundred atmospheres. Representative emissivity calculations were carried out for a transparent gas at a total pressure of 100 atm and a mean beam length of 30 cm. Important emissivity contributions were made by the pressure-induced fundamental vibration-rotation band and rotational lines of H_2 at the lower temperature, i.e., below approximately 4500°K. Above this temperature, the bound-free and free-free transitions of the H^- ion and the continuum and line radiation of the H atom are the most important contributors to the emissivity. The following emission processes were also investigated: the bound-free transitions of the H_2^+ ion, free-free transitions of colliding H atoms and H^+ ions, electronic transitions of the H_2 molecule, quadrupole vibration-rotation transitions of the H_2 molecule, and vibration-rotation transitions of the HD molecule. In addition, the effects of the lowering of the ionization potentials by the fields of plasma ions and of the very broad wings of the Lyman α line were considered. (Contractor's abstract)

207

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

PROPERTIES OF AIR AND PROPELLANT REACTIONS AT HIGH TEMPERATURES AND PRESSURES, by S. S. Penner. Final technical rept. [1960] 3p. incl. refs. (AFOSR-TR-60-162) (AF 18(603)2) Unclassified

A summary of the technical studies considered under this contract and a list of the published literature resulting from those studies are presented. Since June 1, 1960, additional experimental work has been performed on absolute intensity measurements for OH and Ti behind shock fronts and on the decomposition mechanism of NH_3. A great deal of effort was devoted to refining the experimental technique and recording equipment in order to facilitate definitive measurements. The program of refining experimental procedures has largely been completed and preliminary photographic emission spectra have been obtained for Ti at temperatures between 5000 and 10,000°K. Also a theoretical program of emissivity calculations has been initiated for ionized gases containing excited metal atoms.

208

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

RECENT STUDIES ON QUANTITATIVE SPECTROSCOPY AND GAS EMISSIVITIES, by S. S. Penner, D. B. Olfe, and M. Lapp. [1960] [35]p. incl. diagrs. refs. (AFOSR-648) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)2 and Office of Naval Research under Nonr-22003) Unclassified

Presented at ASME Heat Transfer Symposium, New York, Nov. 1960.

Also published in Theory and Fundamental Research in Heat Transfer; Proceedings of the annual meeting of the Amer. Soc. Mech. Engineers, New York (Nov. 1960), New York, Pergamon Press, 1963, p. 117-137.

Representative theoretical and experimental studies relating to the determination of gaseous radiation from isothermal systems are discussed. The emission of OH was observed as a function of time in the axial direction behind the reflected shock wave. It was found that the emitted intensity was a linear function of time after a short induction period, thus indicating that the radiating region was transparent. The value of f-number was obtained as $f = (0.90 \pm 0.10) \times 10^{-3}$. A method is presented for the direct determination of radiative life times and absolute intensities of infrared vibration-rotation bands. The emissivity calculations at 600°K computed from spectroscopic data are in good agreement with observed emissivities and suggests that the model adopted for calculation constitutes a reasonably satisfactory approximation. The emission for temperatures above 10,000°K at high and moderate pressures is essentially unity.

209

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

RADIANT ENERGY EMISSION FROM EXCITED HARMONIC OSCILLATORS, by S. S. Penner. [1960] 3p. (AFOSR-J94) (AF 18(603)2) AD 400064 Unclassified

Also published in Jour. Chem. Phys., v. 32: 617-618, Feb. 1960.

Mathematical verification is presented of the statement that the total radiant energy emission by spontaneous transitions is independent, to the harmonic oscillator approximation of the initially excited vibrational level(s) for a fixed total energy input. It is shown that the rate of radiant energy emission is independent of the value of n (vibrational quantum number of the energy level which is excited initially) for the fixed energy input.

210

California Inst. of Tech. [Guggenheim Jet Propulsion Center] Pasadena.

PROPERTIES OF AIR AND PROPELLANT REACTIONS

AT HIGH TEMPERATURES AND PRESSURES (Abstract), by T. A. Jacobs. [1960] [1]p. (AF 18(603)2)
Unclassified

Presented at First AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, General Dynamics Corp. General Atomic Div., San Diego, Calif., Sept. 6-7, 1960. (AFOSR-TN-60-1033; AD 246174)

A shock tube investigation of the homogeneous decomposition rate of NH_3 has been initiated. By following the rate of decay of radiation in the 3 micron region of the spectrum, an activation energy for the initial rate of decomposition of NH_3 in NH_3 - Ar mixtures has been measured. Current work is concerned with measuring the concentration - time history of the NH radical. The program objective is to establish a basis for formulating a plausible mechanism for the NH_3 decomposition.

211

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

REFLECTION AND TRANSMISSION OF ELECTROMAGNETIC WAVES AT ELECTRON DENSITY GRADIENTS, by F. A. Albini and R. G. Jahn. [1960] [8]p. incl. diagrs. table, refs. [AF 18(603)2]
Unclassified

Published in Jour. Appl. Phys., v. 32: 75-82, Jan. 1961.

Solutions are obtained for the propagation of plane electromagnetic waves parallel to a gradient of free electron density, in the form of complex Airy functions. Reflection and transmission coefficients are derived for normal incidence on a linear "ramp" of electron density connecting a uniform dielectric gas with a uniform ionized gas, as functions of ramp length and propagation exponent of the latter. Machine evaluations of typical cases of physical interest are displayed and discussed. Similar study is made of 2-stage ramps of variable proportions, intended as second approximations to smooth profile transition zones. In each case, the reflection and transmission coefficients are found to depend strongly on ramp width over a range of several tenths of a wavelength, then to oscillate mildly toward the asymptotic values predicted from a WKB-type approximation. The results are less sensitive to the detailed shape of the electron density profile. Propagation through a finite slab of ionized gas bounded on each side by such linear transition zones is formulated and evaluated for typical cases. Asymptotic approximations for the linear ramp problem are found to be inadequate to cover the entire range of interest. The neglect of variation in collision frequency through the transition is discussed and justified for a broad class of equilibrium profiles. (Contractor's abstract)

212

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

SOME PRELIMINARY EXPERIMENTS CONCERNING THE EFFECTS OF STRONGLY DISTORTED INLET FLOW ON THE PERFORMANCE OF AN AXIAL COMPRESSOR, by F. E. Marble and W. H. Heiser. Final rept. June 1960 [45]p. incl. illus. diagrs. (AFOSR-TN-60-869) (AF 49(638)497) Unclassified

Experiments were carried out on the performance of a single-stage and a three-stage axial flow compressor with strong peripheral distortions in the approach flow. The purpose was to augment previous experiments with small peripheral distortion in which the main portion of the results were understandable on the basis of a linearized theory assuming no significant radial flow. In the present experiments, detailed total pressure measurements were made downstream of each blade row involved, completely around the periphery of the machine and the three radii. Due to the complexity of the phenomena and the comparatively small amount of data obtained, the present results are important largely in drawing contrast with the previous information concerning small inlet distortions. The compressor flows with large distortion are very significantly affected by the fact that the augmented flow rate in unblocked regions unloads the compressor stage and significantly alters its operating point. The three-stage compact configuration of the compressor behaves differently from either the compact or expanded single stage with regard to distribution of losses in the first blade rows. There is some indication that the air with low total pressure tends to accumulate at blade roots in the later stages.

213

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

ELECTRODE BOUNDARY LAYERS IN DIRECT CURRENT PLASMA ACCELERATORS, by J. L. Kerrebrock. Jan. 1960 [40]p. incl. diagrs. (Technical note no. 1) (AFOSR-TN-60-287) (AF 49(638)758) AD 236083; PB 146773 Unclassified

Also published in Jour. Aero/Space Sci., v. 28: 631-643, Aug. 1961

One of the problems which must be faced in the development of direct-current plasma accelerators is that of boundary layer growth on the electrode surfaces. These surfaces must be maintained at a somewhat lower temperature than is desirable in the bulk of the gas flow. The associated reduction in electrical conductivity near the electrode surface, together with the continuous current through the boundary layer, may result in greatly augmented Joule heating near the surface, and increased heat transfer. This phenomenon is treated within the frame work of boundary layer theory. It is found that similar solutions for the thermal and viscous boundary

layers exist for a certain class of accelerated flows in which the velocity varies as a power of the streamwise coordinate. The solutions show that the heat transfer rate at Mach numbers near unity may be as much as ten times that which would be expected for a normal boundary layer. At higher Mach numbers, the similarity is not precisely valid; however, the analysis indicates qualitatively that a stagnation enthalpy overshoot may occur in the high temperature portion of the boundary layer as a result of the electromagnetic acceleration. (Contractor's abstract)

214

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

NON-EQUILIBRIUM EFFECTS ON CONDUCTIVITY AND ELECTRODE HEAT TRANSFER IN IONIZED GASES, by J. L. Kerrebrock. Nov. 1960 [44]p. incl. diagrs. tables, refs. (Technical note no. 4) (AFOSR-165) (AF 49(638)758) AD 259911 Unclassified

A simple theory of non-equilibrium conduction in ionized gases has been developed, which accounts for the elevation of the electron temperature by energy gain in the electric field. It is assumed that the ionization is in equilibrium at the electron temperature. The theory yields a modified Ohm's law, such that the current density varies as a power of the electric field. The power is unity for gases at high temperatures, but can be very large at low gas temperatures. Measurements carried out with hot tantalum electrodes in an argon-potassium plasma at temperatures between 1500°K and 2500°K, at atmospheric pressure, agree with the predicted variations of the conductivity with both density and gas temperature. This is regarded as a verification of the assumption of ionization equilibrium at the electron temperature. Both the theory and the experiments indicate that the augmentation of electrode heat transfer by Joule heating in the boundary layer is less important than equilibrium theory predicts it to be. (Contractor's abstract)

215

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

REFLECTION AND TRANSMISSION OF ELECTROMAGNETIC WAVES AT ELECTRON DENSITY GRADIENTS, by F. A. Albini and R. G. Jahn. Oct. 1960 [109]p. incl. diagrs. table, refs. (Technical note no. 3) (AFOSR-1506) (AF 49(638)758) AD 419466 Unclassified

Also published in Jour. Appl. Phys., v. 32: 75-82, Jan. 1961.

Solutions are obtained for the propagation of plane electromagnetic waves parallel to a gradient of free electron density, in the form of complex Airy functions. Reflection and transmission coefficients are derived for normal incidence on a linear "ramp" of electron density connecting a uniform dielectric gas with a uniform ionized gas, as functions of ramp length and propagation exponent of the latter. Machine evaluations of typical cases of physical interest are displayed and discussed. Similar study is made of 2-stage ramps of variable proportions, intended as second approximations to smooth profile transition zones. In each case, the reflection and transmission coefficients are found to depend strongly on ramp width over a range of several tenths of a wavelength, then to oscillate mildly toward the asymptotic values predicted from a WKB-type approximation. The results are less sensitive to the detailed shape of the electron density profile. Propagation through a finite slab of ionized gas bounded on each side by such linear transition zones is formulated and evaluated for typical cases. (Contractor's abstract)

216

California Inst. of Tech. [Mechanical Engineering Lab.] Pasadena.

BEARINGS FOR HIGH VACUUM APPLICATIONS, by R. H. Willens. [1960] [1]p. (AFOSR-3414) (AF 18(600)1561)

Also published in Rev. Scient. Instr., v. 31: 574, May 1960.

The use of Teflon as a lubricant is suggested for bearings of a high vacuum system. It has high stability and low vapor pressure. Lubrication was achieved by continually rubbing a bearing surface against a solid piece of Teflon, thus coating it with a thin layer of Teflon. The procedures used depend upon the type of bearing.

217

California Inst. of Tech. Palomar Observatory, Pasadena.

THE ABUNDANCES OF THE ELEMENTS IN G-TYPE SUBDWARFS, by L. H. Aller and J. L. Greenstein. [1960] [48]p. incl. diagrs. tables, refs. (AFOSR-TN-60-7) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)21) AD 249554 Unclassified

Also published in Astrophys. Jour. Suppl., v. 5: 139-186, Nov. 1960.

The average deficiency of the metals, as compared with the sun, is by a factor of 40 in HD 19445, 100 in HD 140283, and 20 in HD 219617, while HD 161817 shows only small and uncertain deficiencies. The lines of CH were used to obtain an estimate of the carbon abundance, which was found to be very low in the G subdwarfs. There is some evidence for a greater than normal ratio of Ni/Fe. The mean relative abundances of the elements from C to Ba for the three G subdwarfs show some apparently real differences from solar values. The implications of theories of nucleogenesis are discussed. A

rough analysis of the hydrogen-line profiles based on the Kolb-Griem theory of line broadening is shown to be satisfactory, except for an indication that the cores are superposed on broad, nearly undetectable wings.

218

California Inst. of Tech. Palomar Observatory, Pasadena.

A THEORY OF THE ROLE OF MAGNETIC ACTIVITY DURING STAR FORMATION, by E. Schatzman. Jan. 14, 1960, 26p. incl. diagrs. refs. (Special technical rept. no. 3) (AFOSR-TN-60-214) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)21) AD 234150; PB 147318 Unclassified

This report attempts to connect a certain number of facts with the help of only a few new hypotheses. It is assumed that magnetic activity is due to the action of a magnetic field in a rotating star with a convective zone. The theories that stars lose mass from their surface by corpuscular radiation, and that they lose angular momentum through interaction with interstellar medium are both shown to be inadequate. Support is given to the theory of electromagnetic coupling which is described as follows: During flares, jets of matter are produced, which after having locally disturbed the magnetic field, follow the magnetic lines of force up to a point where stresses are no longer sufficiently large to force matter to follow the lines of force. At that point, it can be said that matter leaves the star and carries away some angular momentum. A very small mass loss can thus lead to an enormous loss of angular momentum. This process does not, however, explain the difference between early and late type stars. Stars of the later type have a hydrogen convective zone of great extension (region C); stars of earlier type have no hydrogen convective zone. It is supposed that when a contracting star goes from region C to region D, it stops losing angular momentum, and therefore can reach the main sequence with a high angular velocity. This would establish a basic explanation of distribution of equatorical velocities along the main sequence, the connection between the convective zone, the magnetic activity and the loss of angular momentum. Calculations are also presented on the rate of mass loss, loss of angular momentum during contraction, and magnetic activity. Finally, discussion is presented on stars having P characteristics or these stars which accumulate high values of the abundances of certain non rare elements. The greater the P characteristics, the higher the magnetic field, and it is concluded that these stars had a larger magnetic activity than the others.

219

California Inst. of Tech. Palomar Observatory, Pasadena.

ABUNDANCES IN G DWARF STARS. IV. A REDETERMINATION OF THE ABUNDANCES IN THE HYADES, by R. Parker, J. L. Greenstein and others. [1960] [21]p. incl. diagrs. tables. (AFOSR-TN-60-215) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)21) AD 254066 Unclassified

Also published in Astrophys. Jour., v. 133: 101-106, Jan. 1961.

A redetermination of the abundances of Na, Mg, Si, Ca, Sc, Ti, Cr, Mn, Fe, Ni, and Ba in G dwarfs in the Hyades was carried out. The method was the same as that used in a previous determination (item no. CIT.15:006, Vol. II), but with new material at higher dispersion and with a different telescope and spectrograph. Another star of temperature even closer to that of the sun has been included. The conclusions of the previous study are confirmed and strengthened; there appears to be a small and possibly significant general enrichment of the metals by approximately 20% in the Hyades stars when compared with the sun. Barium is again found to be overabundant by approximately a factor of 2. (Contractor's abstract)

220

California Inst. of Tech. Palomar Observatory, Pasadena.

THE ABUNDANCE OF LITHIUM AND CONVECTIVE MIXING IN STARS OF TYPE K, by W. K. Bonsack. [1960] [30]p. incl. illus. diagrs. tables, refs. (AFOSR-TN-60-216) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)21) Unclassified

Also published in Astrophys. Jour., v. 130: 843-871, Nov. 1959.

The abundance of lithium relative to vanadium, or its upper limit, was determined for 46 normal stars of spectral types from G8 to M0, inclusive. These results are based upon high-dispersion spectrograms obtained with the coudé spectrograph of the 100-in. telescope. The abundance ratio for the sun was also determined, using an equivalent width for lithium measured by Greenstein and Richardson and measurements of vanadium lines in the Utrecht Atlas. In addition, temperatures, electron pressures, and turbulent velocities in the stellar atmospheres were derived. A range of up to a factor of 100 in the abundance ratio is found among stars of similar surface characteristics. The maximum abundance ratio observed among similar stars declines with surface temperature. It is not likely that a significant part of these variations is due to changes in the vanadium abundance. Greenstein and Richardson have proposed that the lithium in the solar surface has been depleted by convective mixing to hotter regions. The possibility that this hypothesis may explain both the trend and the variations in the cooler stars is suggested and discussed. (Contractor's abstract)

221

California Inst. of Tech. Palomar Observatory, Pasadena.

[CONCERNING THE QUESTION OF THE PRESSURE BROADENING OF THE SOLAR BALMER LINES] Zur

Frage der Druckverbreiterung der Solaren Balmerlinien, by R. Cayrel and G. Traving. [1960] [14]p. incl. diagrs. tables, refs. (AFOSR-TN-60-536) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)21) AD 245961 Unclassified

Also published in Zeitschr. Astrophys., v. 50: 239-252, 1960.

The wings of H_α - H_δ and their center-limb-variation have been calculated assuming a homogeneous model of the photosphere and 3 different broadening mechanisms: (1) purely statistical broadening, (2) Holtsmark theory plus electron collisions according to A. C. Kolb and H. R. Griem and finally, (3) taking moreover resistance broadening into account. It turns out that the inclusion of electron collisions markedly improves the agreement with observed profiles and that at least for H_α the influence of resonance broadening is also important. Furthermore, comparison with observation indicates, that in earlier experiments H_γ and H_δ apparently had been assumed a position of the continuum too low by about 5%. The influence of temperature inhomogeneities, which was neglected in the numerical calculation, has been estimated. It is expected that the depth of the wings increases only slightly if $\Delta T/T$ is of the order of ±5%, a value supported by recent measurements of the granulation. (Contractor's abstract)

222

California Inst. of Tech. Palomar Observatory, Pasadena.

THE ABUNDANCE OF LITHIUM IN T TAURI STARS: FURTHER OBSERVATIONS, by W. K. Bonsack. [1960] 7p. incl. table. (AFOSR-TN-60-896) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)21) AD 253731 Unclassified

Also published in Astrophys. Jour., v. 133: 340-343, Jan. 1961.

This research sought to determine if high lithium abundances are common to all T Tauri stars and whether such abundances are exclusive properties of these stars. Spectrograms of the region of the Li I doublet at λ6708 were obtained for as large a number as possible of appropriate stars. Of the 7 stars photographed, all show high abundances of lithium, and, in all, 12 T Tauri stars studied in 2 investigations have lithium abundances relative to the heavier metals of the order of 100 times the solar value, and none have less. These stars are concentrated in 2 groups, one in the nebulosity in the Tauri-Auriga region and one in the Orion nebula. Both groups are near galactic latitude -13°, and have galactic longitudes differing by about 30°. Thus the separation of the groups is of the order of their distance from the sun. The unanimity of the abundance result therefore makes reasonable the assertion that not only is high lithium abundance a common property of the T Tauri stars in the Tauri-Auriga and Orion, but that all T Tauri stars within a few hundred parsecs of the sun have high lithium abundances.

223

California Inst. of Tech. Palomar Observatory, Pasadena.

THE ABUNDANCE OF BERYLLIUM IN FOUR STARS OF TYPE A, by W. K. Bonsack. [1960] [10]p. incl. diagr. table, refs. (AFOSR-TN-60-897) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)21) AD 261991 Unclassified

Also published in Astrophys. Jour., v. 133: 551-561, Mar. 1961.

By means of a curve-of-growth analysis of high-dispersion spectrograms, the ratio of the abundance of Be to that of Fe was determined for α^2 CVn (A0p) and α CMa (A1 V) relative to the ratio in α Lyr (A0 V). In addition, the position of α Gem A (A1 V) on the abundance scale so defined was estimated. The absolute ratio of Be to H was obtained for α Lyr with the aid of a published model atmosphere. The results show that the abundance of Be in α Lyr is approximately one-fourth of the solar abundance ($Be/H = 10^{-10}$); the Be-to-Fe ratio in α CMa is at least 40 times less than in α Lyr, and in α^2 CVn it is 25 times more. The abundance ratio in α Gem A appears to be similar to that in α Lyr. The absence of Be in α CMa is interpreted as a possible consequence of the transfer of matter from its white dwarf companion when the latter was an M super-giant. The Be abundance difference between α^2 CVn and α Lyr, together with the apparent absence of mechanisms to reduce the initial surface abundance in α Lyr more than in α^2 CVn, suggest the active production of Be on the surface of α^2 CVn, probably in the early phases of its evolution. This suggestion, taken together with the evidence available on the abundance of lithium, indicates that the origin of Li, Be, and B is probably in nuclear processes at the surfaces of newly formed stars. (Contractor's abstract)

224

California Inst. of Tech. [Palomar Observatory] Pasadena.

ABUNDANCES IN G DWARFS. V. THE METAL-RICH STAR 20 LEO MINORIS AND TWO COMPARISON STARS, by G. Wallerstein and H. L. Helfer. [1960] [4]p. incl. diagrs. tables. (AFOSR-TN-60-1000) (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) (AF 49(638)21) AD 261990 Unclassified

Also published in Astrophys. Jour., v. 133: 562-565, Mar. 1961.

A total of 20 LMi was found to be overabundant in 11 elements by a factor of 2 when compared with the sun. The

uncertainties in the analysis admit the possibility that the overabundance is as small as that in the Hyades (25%) to as large as a factor of 3 greater than the sun. The low-velocity star HD 187923 has a slight excess of metals, and the high-velocity star HD 30649 is deficient in metals by a factor of 2. Both HD 187923 and HD 30649 are deficient in manganese relative to the other 10 elements studied. (Contractor's abstract)

225

California Inst. of Tech. [Palomar Observatory] Pasadena.

OSCILLATOR STRENGTHS OF LEAD AND THE LEAD ABUNDANCE IN THE SUN, by T. M. Helliwell. [1960] [6]p. incl. diagr. tables, refs. (AFOSR-TN-60-1001) (AF 49(638)21) AD 261993 Unclassified

Also published in Astrophys. Jour., v. 133: 566-571, Mar. 1961.

The oscillator strengths of 4 transitions in neutral lead have been calculated and compared with recent experimental results. The method of calculation is described. These values are used to investigate the problem of lead abundance in the sun, which is compared with the abundance predicted by the theory of stellar nucleosynthesis. (Contractor's abstract)

226

California Inst. of Tech. Palomar Observatory, Pasadena.

CORONAL EVAPORATION AS A POSSIBLE MECHANISM FOR MASS LOSS IN RED GIANTS, by R. Weymann. [1959] [24]p. incl. diagrs. tables, refs. (AFOSR-J60) (AF 49(638)21) AD 400376 Unclassified

Also published in Astrophys. Jour., v. 132: 380-403, Sept. 1960.

The consequences of the possible existence of a corona of a red giant were investigated from a hydrodynamic point of view, under the assumption that deposition of mechanical energy is confined to a narrow layer just above the surface of the star. Because of the energy losses due to radiation, steady subsonic flows do not exist, and only under special circumstances can hydrostatic solutions exist. In contrast, steady supersonic flows can exist, and the mass accompanying them would be significant from an evolutionary point of view. However, investigation of the observational consequences of such flows rules them out because of the expected presence of lines displaced toward much higher velocities than those actually observed. Other possible models for mass ejection are briefly discussed. (Contractor's abstract)

227

California Inst. of Tech. Palomar Observatory, Pasadena.

NEW NEUTRON SOURCES OF POSSIBLE ASTROPHYSICAL IMPORTANCE (Abstract), by A. G. W. Cameron. [1960] [1]p. (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) [AF 49(638)21] Unclassified

Presented at 106th meeting of Amer. Astronom. Soc., Universidad Nacional de Mexico, Mexico City, Aug. 22-25, 1960.

Published in Astronom. Jour., v. 65: 485, Nov. 1960.

Sources capable of providing up to 40 neutrons per initial silicon atom in a star are revealed. Previously announced helium-burning neutron sources seem inadequate owing to the probable small abundances of C^{13} and Ne^{21} following hydrogen thermonuclear reactions in a stellar interior. These convert most of the original C, N, and O nuclei into N^{14}. However, when helium-burning starts, the reactions $N^{14}(\alpha,\gamma)F^{18}(\beta^{+}\nu)O^{18}$ and $O^{18}(\alpha,\gamma)Ne^{22}$ should readily take place. Temperatures near 2×10^{8}°K are needed to destroy Ne^{22}; if these should be available near the end of the helium-burning, then the reactions $Ne^{22}(\alpha,\gamma)Mg^{26}$ and $Ne^{22}(\alpha,n)Mg^{25}$ should occur. This should produce a number of neutrons entirely adequate for heavy element synthesis. It also appears likely that a large rate of energy loss by neutrino-antineutrino pair emission near 10^{9}°K will cause carbon thermonuclear reactions to take place either at high rates of energy generation or explosively. Two possible sequences of reactions can release a burst of neutrons when partly burned carbon explodes, transforming heavy elements into a new neutron-rich abundance pattern. Carbon pycnonuclear ignition of a Type I supernova explosion would yield a very strong burst of neutrons also. In view of all the neutron sources which now seem possible, it is difficult to predict which stellar objects are responsible for making the heavy elements.

228

California Inst. of Tech. Palomar Observatory, Pasadena.

MODEL ATMOSPHERES AND CONVENTIONAL CURVE OF GROWTH ANALYSIS (Abstract), by R. Cayrel. [1960] [1]p. (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) [AF 49(638)21] Unclassified

Presented at 106th meeting of the Amer. Astronom. Soc., Universidad Nacional de Mexico, Mexico City, Aug. 22-25, 1960.

Published in Astronom. Jour , v. 65: 486, Nov. 1960.

Possible systematic differences between abundances

derived for the conventional curve of growth analysis and from detailed model atmosphere computations were investigated. They have been found to be small, usually less than the sum of the errors arising from observational inaccuracy and incorrect assumptions in the theory. The main advantage of using models seems, therefore, to be confined to the use of more observational data to determine the physical parameters, temperature and gravity. Color, Balmer jump, and profiles of the Balmer lines are such examples. In addition, the use of models removes the uncertainty in the connection between the excitation and ionization temperatures.

229

California Inst. of Tech. Palomar Observatory, Pasadena.

SURFACE AND BRIGHTNESS TEMPERATURES FROM THE CENTRAL INTENSITIES OF BALMER LINES (Abstract), by G. Cayrel. [1960] [1]p. (In cooperation with Mount Wilson Observatory, Pasadena, Calif.) [AF 49(638)21] Unclassified

Presented at 106th meeting of the Amer. Astronom. Soc., Universidad Nacional de Mexico, Mexico City, Aug. 22-25, 1960.

Published in Astronom. Jour., v. 65: 486, Nov. 1960.

According to the local thermodynamic equilibrium picture, the pseudocontinuum formed by the central intensities of strong saturated lines (the first Balmer lines, for instance) is given by the energy distribution of a blackbody at the surface temperature T_0. Surface temperatures have been derived by this method for 33 stars. They are in reasonable agreement between spectral type B5-F8 with expected surface temperatures from model atmospheres. Using a few eclipsing variables this method was checked and the radii of these variables when their parallaxes are known are derived. The limb-darkening constants of the 33 stars was also calculated.

230

California Inst. of Tech. Seismological Lab., Pasadena.

FURTHER STUDY OF THE MECHANISM OF CIRCUM-PACIFIC EARTHQUAKES FROM RAYLEIGH WAVES, by K. Aki. [1960] [8]p. incl. diagrs. tables. (AFOSR-2964) (Sponsored jointly by Air Force Office of Scientific Research and IGY Interdisciplinary Research Program under AF 49(638)910) Unclassified

Also published in Jour. Geophys. Research, v. 65: 4165-4172, Dec. 1960.

The source functions of 3 earthquakes in the western Pacific are obtained from Rayleigh waves recorded at many IGY stations over the world. A method of interpreting the source is applied to these source functions. It is found that the pattern of the force at the source is quadrant for all 3 earthquakes, in accordance with the model adopted in the fault plane studies. One of the 2 nodal lines is found to be nearly parallel to the trend of the seismic zone for each of these earthquakes, and if the nodal line is taken as the actual fault, the slip directions are right hand for all three. The result from the recent Chilean shocks also supports the hypothesis that right hand strike-slip prevails along the circum-Pacific earthquake belt. (Contractor's abstract)

231

[California U., Berkeley.]

RARE EARTH RESEARCH; A SEMINAR, Lake Arrowhead, Calif., Oct. 1960, ed. by E. V. Kleber. New York, MacMillan Co., 1961, 313p. incl. illus., diagrs. tables, refs. (AFOSR-1798) (Sponsored jointly by Air Force Office of Scientific Research, California U., Nuclear Corporation of America, and Office of Naval Research) Unclassified

The Arrowhead conference sought to bring together many of the individuals and institutions engaged in research on that novel assortment of elements in Group III of the periodic table - the rare earths and to discuss current research rather than summarize previous work. Copies of all papers were distributed prior to the seminar and the sessions themselves consisted of discussion of the papers. The seminar was divided into five parts: (1) solution chemistry, (2) oxide systems and their properties, (3) structure of metals, alloys, and intermetallics, (4) physical properties of metals, alloys, and intermetallics, and (5) mechanical and metallurgical properties of metals, alloys, and intermetallics.

232

California U. Dept. of Chemistry, Berkeley.

THE CHEMILUMINESCENCE OF ETHYLENE FORMED PROBABLY FROM METHYLENE IN AN INERT MATRIX, by T. D. Goldfarb and G. C. Pimentel. Feb. 10, 1960 [12]p. incl. diagrs. refs. (AFOSR-TN-60-182) (AF 49(638)1) AD 233368; PB 146718 Unclassified

Also published in Jour. Chem. Phys., v. 33: 105-108, July 1960.

An orange-red luminescence occurs when diazomethane suspended in solid nitrogen or solid argon is photolyzed and then warmed to permit diffusion. Spectrographic and visual studies of this thermoluminescence are reported here. Conditions favorable for the production of the luminescence also result in relatively high yields of ethylene as a final product. Furthermore, a deuteration effect is observed. For CH_2N_2 the recorded spectrum consists of a distinct feature at 6030A and an extremely weak feature near 6530A. Deuterated diazomethane produces a spectrum with 2 distinct features at 6055 and 6405A and 1 or more weaker absorptions between 6700

and 6800A. The emission is assigned to chemiluminescence of ethylene and a tentative interpretation is given in terms of 2 excited states of ethylene (Z - V). (Contractor's abstract)

233

California U. Dept. of Chemistry, Berkeley.

PHOTOLYSIS OF CARBON DIOXIDE, by B. H. Mahan. [1960] [22]p. incl. diagrs. tables. (AFOSR-TN-60-472) [AF 49(638)1] AD 237420; PB 147337 Unclassified

Also published in Jour. Chem. Phys., v. 33: 959-965, Oct. 1960.

The vacuum ultraviolet photolysis of carbon dioxide was investigated. Kinetic data and quantum yield measurements indicate that electronically excited (^1D) oxygen atoms are produced in the primary process at 1470A and 1236A. Such a primary process is consistent with the tentative spectral assignments which have been made for carbon dioxide. (Contractor's abstract)

234

California U. Dept. of Chemistry, Berkeley.

LIGHT-INDUCED cis-trans ISOMERIZATION OF NITROUS ACID FORMED BY PHOTOLYSIS OF HYDRAZOIC ACID AND OXYGEN IN SOLID NITROGEN, by J. D. Baldeschwieler and G. C. Pimentel. [1960] [8]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1018) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)1] and American Petroleum Institute) AD 246358; PB 153051 Unclassified

Also published in Jour. Chem. Phys., v. 33: 1008-1015, Oct. 1960.

Photolysis of hydrazoic acid in solid nitrogen at 20°K with oxygen present yields both cis- and trans-nitrous acid. The identification is based on infrared detection of features of the isotopically substituted species HONO, DONO, and $HO^{18}NO^{18}$. The nitrous acid probably results from the reaction of imidogen with oxygen. Isomerization of nitrous acid occurs in the matrix at 20°K under the influence of irradiation. Ultraviolet radiation causes the trans- to cis-reaction, probably by electronic excitation to give a random mixture of the 2 forms. Near infrared radiation reverses the reaction but the role of the radiation is not known. Bulk heating of the sample is not involved and a broad range of near infrared frequencies is effective. No isomerization of DONO could be detected and $HO^{18}NO^{18}$ seemed to isomerize more slowly than did HONO. Only speculative interpretations of this phenomenon can be made at this time. (Contractor's abstract)

235

California U. Dept. of Chemistry, Berkeley.

RADICAL FORMATION AND TRAPPING IN THE SOLID PHASE, by G. C. Pimentel. [1960] [45]p. incl. diagrs. tables, refs. [AF 49(638)1] AD 438465 Unclassified

Published in Formation and Trapping of Free Radicals, New York, Academic Press Inc., 1960, p. 69-115.

The formation of free radicals by generation of the species in situ in a solid is considered. It is pointed out that photolysis offers the most controlled means of producing free radicals in the solid state. There are limitations such as the possible inhibition of fragmentation by the matrix and the restriction to photosensitive precursors. Radiolysis has greater versatility in that energy limitations on the possible chemical processes are no longer present. Electron bombardment, like radiolyis however, is not sufficiently discriminating to provide controlled reactions. Infrared methods are most informative of the details of the processes accompanying free radical production. It is concluded that whichever method is considered best for a particular situation, all investigators agree that in situ production of free radicals is a lucrative method of study.

236

California U. Dept. of Chemistry, Berkeley.

AN LCAO TREATMENT OF THE ACIDITY OF HYDROCARBONS, by A. Streitwieser, Jr. Mar. 3, 1960, 16p. incl. diagrs. tables. (AFOSR-TN-60-162) (AF 49(638)-105) AD 233688 Unclassified

Also published in Tetrahedron Ltrs., No. 6: 23-29, Mar. 1960.

Determinations were made of the extent to which the simple molecular orbital theory quantitatively correlates the pK values of McEwen (Jour. Amer. Chem. Soc., v. 58: 1124-1129, July 1936) and acidities of some hydrocarbons. The following assumptions were made: (1) the acidity of hydrocarbon is proportional to the change in the π-bond energy resulting from the difference in configuration between the hydrocarbon and the corresponding anion; (2) effects such as changes in σ-bond energies and solvation are relatively constant from one system to another; and (3) strain energy is the same in both the hydrocarbon and anion. Correlation of acidities with simple molecular orbital calculations was plotted. In the scatter of points a good straight line emerged through the compounds whose anions were expected to be completely coplanar. The anions of the other compounds containing aryl groups were less acidic than predicted by the correlation by about 4 pK points per nonplanar phenyl group. In all of the predicted results the anion-stabilizing character of the 5-membered ring was evidenced.

237

[California U. Dept. of Mathematics, Berkeley.]

ENERGY INEQUALITIES FOR THE SOLUTION OF DIFFERENTIAL EQUATIONS, by M. Lees. [1960] [16]p. (AF 18(600)1117) Unclassified

Published in Trans. Amer. Math. Soc., v. 94: 58-73, Jan. 1960.

This report considers the hyperbolic operator $Mu(x,t) = \frac{\partial^2 u}{\partial t^2} - a(x,t)\frac{\partial^2 u}{\partial x^2}$ where $0 < \mu_1 \le a(x,t) \le \mu_2$, $|a(x,t) - a(x',t')| \le \mu_0[|x - x'| + |t - t'|]$, $0 \le x, x' \le 1$, $0 \le t, t' \le t_0$. It is known that for every $u(x, t) \in C^2$, $u(0, t) = u(1, t) = 0$, there exists a constant C, depending only on $\mu_i (i = 0, 1, 2)$ and t. In theorem 1, a significant result of the paper, an analogous inequality for a finite difference operator L which is consistent with M is proven. It follows that L is stable in the mean square norm, without restriction to the mesh ratio h/k. Some non-linear cases and semi-discrete approximations of the operator M are also considered. In all these cases, corresponding energy inequalities are derived. In these proofs, some interesting "discrete" lemmas are obtained.

238

California U. Dept. of Mathematics, Berkeley.

HOMOTOPY-ABELIAN LIE GROUPS, by S. Araki, I. M. James, and E. Thomas. June 1960, 5p. (Technical rept. no. 13) (AFOSR-TN-60-487) (AF 49(638)79) AD 244906; PB 152606 Unclassified

Also published in Bull. Amer. Math. Soc., v. 66: 324-326, July 1960.

A topological group G is said to be homotopy-abelian if the commutator map of G x G into G is nulhomotopic. The following theorem is proved: A compact connected Lie group is homotopy-abelian only if it is abelian. (Contractor's abstract)

239

California U. Dept. of Mathematics, Berkeley.

ON HOMOTOPY - COMMUTATIVITY, by I. [M.] James and E. Thomas. June 1961, 23p. incl. refs. (Technical rept. no. 14) (AFOSR-TN-60-844) (AF 49(638)79) AD 259877 Unclassified

Also published in Ann. Math., v. 76: 9-17, July 1962.

A technical criterion of the Steenrod powers in the classifying spaces is presented. Using this and detailed computations, the standard representation of G in H is proven not to be homotopy-commutative in the following cases: (1) U(n) in U(2n - 1); (2) G_2 in Spin (11); (3) Spin (9) in F_4.

240

California U. Dept. of Mathematics, Berkeley.

A PROPERTY OF THE SYMPLECTIC GROUP, by D. Maurer. Nov. 1960, 11p. incl. diagrs. (Technical rept. no. 17) (AFOSR-TN-60-908) (AF 49(638)79) AD 252644 Unclassified

Let C_n be the group of all complex n x n matrices leaving a skew-symmetric quadratic form invariant, and let $\underline{C}_n$ be its Lie algebra. Its Weyl group is a finite group of linear transformations of its Cartan subalgebra generated by the reflections R_σ, where σ is a root of $\underline{C}_n$ and for any vector v in a space V the reflection R_v is defined by $R_v(w) = w - 2\langle w,v\rangle v$. It is the purpose of this paper to investigate this problem from the opposite direction and by using facts about Lie algebras, to uncover facts about their Weyl groups, particularly a classification of their representations. The result, however, is true only for the unitary and symplectic groups and for the exceptional group G_2. It is shown that there exists a one-to-one correspondence between conjugate classes of the Weyl group and conjugate classes of regular subalgebras.

241

California U. Dept. of Mathematics, Berkeley.

LIE ALGEBRA COHOMOLOGY AND THE GENERALIZED BOREL-WEIL THEOREM, by B. Kostant. Sept. 1960, 100p. (Technical rept. no. 16) (AFOSR-TN-60-1061) (AF 49(638)79) AD 244907; PB 152607 Unclassified

Also published in Ann. Math., v. 74: 329-387, Sept. 1961.

A technique employing only representation theory is introduced which determines the cohomology groups associated with a familiar family of nilpotent Lie algebras. The complex Lie algebra $\underline{a}$ is restricted such that a Laplacian can be defined on the cochain complex $C(\underline{a}, V)$ so that the determination of the cohomology group $H(\underline{a}, V)$ becomes the problem of finding the kernel of the Laplacian. Among applications, the Borel-Weil theorem and Weyl's character formula are proved. Results are used in a related paper in an extension of the Schubert calculus.

242

California U. Dept. of Mathematics, Berkeley.

PROPERTIES OF SOLUTIONS OF PARABOLIC

EQUATIONS AND INEQUALITIES, by M. H. Protter. Mar. 1960, 24p. (Technical rept. no. 8) (AFOSR-TN-60-282) (AF 49(638)398) AD 234945 Unclassified

Also published in Canad. Jour. Math., v. 13: 331-345, 1961.

The asymptotic behavior of solutions of parabolic inequalities and the uniqueness of the Cauchy problem for such inequalities when the data are prescribed on a portion of a time-like surface are considered. Parabolic operators of the form

$L \equiv \frac{\partial}{\partial t} - \sum_{i,j=1}^{n} \frac{\partial}{\partial x_i} \left(a_{ij} \frac{\partial}{\partial x_j}\right)$, $a_{ij} = a_{ji}$; and

$M \equiv \frac{\partial}{\partial t} - \sum_{i,j=1}^{n} b_{ij} \frac{\partial^2}{\partial x_i \partial x_j}$, $b_{ij} = b_{ji}$, are considered, where the coefficients $a_{ij}(x,t) = a_{ij}(x_1,x_2,\ldots,x_n,t)$ are C' functions of x and t, and the $b_{ij} = b_{ij}(x,t)$ are C^2 functions of (x,t). The portions of the operators

$F \equiv \sum_{i,j} \frac{\partial}{\partial x_i} \left(a_{ij} \frac{\partial}{\partial x_j}\right)$, $G \equiv \sum_{i,j} b_{ij} \frac{\partial^2}{\partial x_i \partial x_j}$ are assumed to be uniformly elliptic throughout the domain under consideration.

243

California U. Dept. of Mathematics, Berkeley.

ASYMPTOTIC BEHAVIOR AND UNIQUENESS THEOREMS AND HYPERBOLIC EQUATIONS AND INEQUALITIES, by M. H. Protter. Mar. 1960, 19p. (Technical rept. no. 9) (AFOSR-TN-60-300) (AF 49-(638)398) AD 235217; PB 149646 Unclassified

Inequalities of the form $|Lu| \leq c_1 |u| + c_2 \sum_{i=1}^{n} |\frac{\partial u}{\partial x_i}| + c_3 |\frac{\partial u}{\partial t}|$ are considered, where $L = A - \frac{\partial^2}{\partial t^2}$ and A is an elliptical operator. Let D be a bounded domain in E^n and suppose u(x, t) is a solution of Lu in the cylindrical domain $R = D \times I$, where I is the half-infinite interval $0 \leq t \leq \infty$. If, in addition, $u = 0$ on the lateral boundary of this cylinder, then u cannot tend to zero too rapidly. If $u \to 0$ as $t \to \infty$ faster than any power of t, then $u \equiv 0$ in $D \times I$. Hypotheses are required only with regards to the quantities c_i, $i = 1,2,3$ and the coefficients of A. The wave motion which distinguishes hyperbolic equations also extends to hyperbolic inequalities. In fact such motions cannot decay exponentially so long as the operator A has a zero order term which is negative and satisfies a growth condition in t. The question of the uniqueness of the Cauchy problem for hyperbolic inequalities is also discussed. The distance function $r^2 = t^2 - \sum_{i=1}^{n} x_i^2$ is introduced and the inequality established in which β is a parameter which is supposed sufficiently large, $0 < r < 1$ and the m_i, $i = 1,2,3$ are again constants. With the aid of the above relation, valid for C' functions with piecewise continuous second derivatives, it is possible to establish the uniqueness of the Cauchy problem for certain domains. The uniqueness problems for the surfaces considered are related to the question of the properties of Cauchy data for hyperbolic equations when prescribed on a time-like surface.

244

California U. Dept. of Mathematics, Berkeley.

LOWER BOUNDS FOR THE FIRST EIGENVALUE OF ELLIPTIC EQUATIONS OF ORDERS TWO AND FOUR, by W. W. Hooker. Aug. 1960, 47p. incl. tables, refs. (Technical rept. no. 10) (AFOSR-TN-60-806) (AF 49-(638)398) AD 241793; PB 150806 Unclassified

This dissertation is concerned with the analytic and numerical study of a new method of obtaining lower bounds for the first eigenvalue of elliptic differential equations. There is a theorem of Temple which bounds the first eigenvalue between the minimum and maximum of a certain differential expression containing an arbitrary function. If this function is the eigenfunction of the problem, the bounds coincide with the eigenvalue. In the present method the lower bound is also the minimum of a differential expression, but now involving a set of arbitrary functions. It is possible to select these functions in such a way that Temple's lower bound is obtained as a special case. However, other choices are often more advantageous since they permit a wider variety of techniques in optimizing the lower bound. A number of such equation corresponds to a vibrating membrane. In many cases the lower bound obtained is better than existing bounds. (Contractor's abstract)

245

California U. Dept. of Mathematics, Berkeley.

ON DIFFERENCE METHODS FOR THE SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS OF MIXED TYPE, by H. Ogawa. Oct. 1960, 2v. incl. diagrs. (Technical rept. no. 11) (AFOSR-TN-60-1026) (AF 49(638)-398) AD 245313; PB 152715 Unclassified

The problem of solving boundary and initial value problems for certain partial differential equations of mixed type by finite difference methods is considered. A general mixed-type equation whose difference approximation has a solution which satisfies a maximum principle is investigated. The conditions under which the solution of the differential equation satisfies a maximum principle are found to be sufficient for the solution of the difference equation to satisfy an analogous principle, except near the parabolic line where additional conditions are required. Finite difference methods are employed for the solution of an equation which is hyperbolic in the interior of a domain and parabolic on the line which carries the initial data. As in the boundary value

problem, a maximum principle for a suitable difference equation yields an approximate solution which converges to the solution of the differential equation as the mesh size tends to zero. The conditions under which the differential equation has the maximum property are found to imply that the difference equation has the property, except near the parabolic line. An existence theorem for the solution to the boundary value problem for an equation which is hyperbolic in the interior of a domain and parabolic on a part of the curve carrying the boundary values is proved by the finite difference techniques. (Contractor's meeting)

246

California U. [Dept. of Mathematics] Berkeley.

LOWER BOUNDS FOR THE FIRST EIGENVALUE OF ELLIPTIC EQUATIONS, by M. H. Protter. [1960] [22]p. incl. refs. (AF 49(638)398) Unclassified

Published in Ann. Math., v. 71: 423-444, May 1960.

The eigenvalue problem is considered whose first eigenvalue is characterized by the minimum principle

$$\lambda_1 = \min_{\varphi} \iint_{\mathcal{D}} \sum_{i,j=1}^{n} a^{ij} \frac{\partial \varphi}{\partial x_i} \frac{\partial \varphi}{\partial x_j} \, dV / \iint_{\mathcal{D}} \varphi^2 dV$$ defined

on a simply connected n-dimensional region $\mathcal{D}$ with boundary Γ. The minimum is taken among all piecewise smooth functions φ which vanish on Γ. It is assumed

that $C_0 \sum_{i=1}^{n} \xi_i^2 \le \sum_{i,j=1}^{n} a^{ij} \xi_i \xi_j \le C_1 \sum_{i=1}^{n} \xi_i^2$ for all

real quantities ξi, where C_0 and C_1 are positive constants. It follows that the addition of a divergence term

of the type $\iint_{\mathcal{D}} \sum_{i=1}^{n} \frac{\partial}{\partial x_i} (\rho^i \varphi^2) dV$ (which by Green's

theorem is zero) to the numerator of the Rayleigh quotient and regrouping, that $\lambda_1 \ge \min[\rho, i^i - a_{j1}\rho^j \rho^1]$. Here a_{j1} is the inverse of a^{j1}, and ρ^j is an arbitrary vector. In the particular case of the ordinary membrane equation, an algorithm is developed which yields an increasing sequence of lower bounds for λ_1. This method is compared with that of symmetrization, and the report is concluded by extending the method to treat eigenvalue problems for elliptic equations of arbitrary order. (Math. Rev. abstract)

247

California U. [Dept. of Mathematics] Berkeley.

TOROIDAL ALGEBRAIC GROUPS, by M. Rosenlicht. [1960] [5]p. (AFOSR-3338) (AF 49(638)603) Unclassified

Also published in Proc. Amer. Math. Soc., v. 12: 984-988, Dec. 1961.

Let G be a connected algebraic group. It is observed that the following three conditions on G are equivalent: (1) The maximal connected linear algebraic subgroup of G is a torus, i.e., is a direct power of the multiplicative group G_m. (2) No algebraic subgroup of G is isomorphic to the additive group G_a. (3) For each connected algebraic subgroup H of G the set of points of H which have finite order not divisible by the field characteristic is dense in H. G satisfying these conditions is called toroidal. A toroidal group is always commutative; the property of being toroidal is preserved by isogeny, epimorphism, passing to a connected algebraic subgroup, and passing to an extension by a toroidal group. Three theorems of toroidal groups analogous to results for abelian varieties are proven of which the following is an example: An everywhere defined rational map of a connected algebraic group into a toroidal group mapping neutral element onto neutral element is always a homomorphism. A new proof of the following theorem is also given: If G is defined over a finite field and A is the maximal abelian subvariety of G, then G = AL. Without the condition of finiteness the conclusion is invalid. (Math. Rev. abstract)

248

California U. Dept. of Mathematics, Berkeley.

DISTRIBUTIONS AND GENERAL THEORY OF DIFFERENTIAL OPERATORS, by F. Treves. Jan. 1960, 1v. (Technical rept. no. 1) (AFOSR-TN-60-34) (AF 49(638)604) AD 232500; PB 146082 Unclassified

A study is presented of the general theory of linear partial differential operators and its applications to the theories of topological linear spaces and distributions. The following theorems are proved: existence and construction of a fundamental solution for any differential polynomial, characterization of hypo-elliptic operators with constant coefficients, approximation of solutions to the homogeneous equation by exponential polynomials solutions and existence of solutions to the inhomogeneous equation. A proof is given of the interior regularity of the solutions of an elliptic equation (with C^∞ coefficients). (Contractor's abstract)

249

California U. Dept. of Mathematics, Berkeley.

FUNCTIONS VALUED IN VARIABLE NORMED SPACES, by F. Treves. Jan. 1961, 89p. (Technical rept. no. 2) (AFOSR-TN-60-1201) (AF 49(638)604) AD 254.16; PB 155606 Unclassified

Conditions are investigated under which the concepts and methods of analysis can be extended to functions defined in a set X and whose values at each point x of

X lie in a set E(x) depending on x. Here the sets E(x) are normed (real or complex) vector spaces. Only very fundamental aspects are studied: In Chapter II, continuity, measurability and integration; and in Chapter III, differentiability of those functions. The arguments of Chapter II follow essentially the trend developed by various authors, especially in the theory of representations of algebras. The main difference is that a structure is sought where possibly no continuous functions on open sets (beside the zero section) exist, although a meaningful theory of integration can be built. That has led to defining continuity on every subset of the base space X by using a suitable structure given over this subset. An other difference is that one weakens substantially the condition on the norms of the regular functions. Chapter III is concerned with the definition of differentiable sections, which in some sense, constitutes the core of the article. Examples of a general nature are given. (Contractor's abstract, modified)

250

California U. [Dept. of Mathematics] Berkeley.

PROCEEDINGS OF THE FOURTH BERKELEY SYMPOSIUM ON MATHEMATICAL STATISTICS AND PROBABILITY, California U., Berkeley, June 20-July 30, 1960, ed. by J. Neyman. Los Angeles, California U. Press, 1961, 4v. incl. illus. diagrs. tables, refs. (AFOSR-2135) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)738, California U., National Institutes of Health, National Science Foundation, Office of Naval Research, and Office of Ordnance Research) Unclassified

The fourth Berkeley Symposium sought to represent a comprehensive cross section of contemporary thinking on problems of probability and mathematical statistics. The published proceedings appear in four volumes. Volume I is given to the theory of statistics. Volume II contains papers on probability. Applications to physical sciences are published in Volume III and the last volume is given to biology and problems of medicine.

251

California U. [Dept. of Physics] Berkeley.

PHYSICAL ATMOSPHERIC PARAMETERS FOR LATE-TYPE STARS, by M. S. Vardya. [1960] [23]p. incl. diagrs. tables. (AFOSR-4049) (AF 49(638)299) Unclassified

Also published in Astrophys. Jour., v. 133: 107-129, Jan. 1961.

For a gas mixture, the relation between total gas pressure, partial pressure of atomic hydrogen, mean molecular weight, and several other auxiliary quantities has been determined as a function of electron pressure and $\theta = 5040/T$, for 3 hydrogen-to-helium abundance ratios. The effect of molecular hydrogen has been incorporated.

252

California U. Dept. of Physics, Berkeley.

SOME RIGOROUS ANALYTIC PROPERTIES OF TRANSITION AMPLITUDES, by S. Mandelstam. [Dec. 1959] 47p. incl. refs. (AFOSR-TN-60-116) (AF 49(638)327) AD 236742 Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 51, Jan. 27, 1960.

Also published in Nuovo Cimento, Series X, v. 15: 658-685, Feb. 16, 1960.

The causality and mass-spectral conditions are used to derive analytic properties of two-particle transition amplitudes as functions of energy and momentum transfer. While the complete double-dispersion representation cannot be proved from these postulates alone, it is shown that, within a certain domain in the space of two complex variables, the only singularities are the expected poles and cuts along the real axis. This domain surrounds the low-energy physical region. The proof is restricted to the scattering of the lightest particles in the theory. As long as no attempt is made to find the largest possible domain, the calculations are not very difficult. The domain of analyticity can then be extended by the unitarity condition. The magnitude of the extension is not very large, but the new domain differs from the old in including part of the region in which the two-dimensional spectral functions are non-zero. We only use the unitarity condition below the threshold for inelastic processes; if such processes could also be treated and the unitarity condition used at higher energies, it seems possible that the domain could be extended arbitrarily far. In the present results, the boundary of the domain of analyticity is sufficiently far from the low energy region to justify the analytic properties assumed in applications of the double-dispersion representation. Other results that can be proved are that partial-wave amplitudes are analytic functions of the energy in a certain region, that the determination of coupling constants by extrapolation in the angle is valid if the energy is not too high, and that ordinary dispersion relations are true over a slightly larger range of momentum transfer than had previously been established. (Contractor's abstract)

253

California U. Dept. of Physics, Berkeley.

S-WAVE-DOMINANT SOLUTIONS OF THE PION-PION INTEGRAL EQUATIONS, by G. F. Chew, S. Mandelstam, and H. P. Noyes. Nov. 17, 1959, 16p. incl. diagrs. (Rept. no. UCRL-9001) (AFOSR-TN-60-117) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)327 and Atomic Energy Commission) AD 233686 Unclassified

Also published in Phys. Rev., v. 119: 478-481, July 1, 1960.

The integral equations for pion-pion scattering are put into a form suitable for numerical solution. An iteration procedure is described that is applicable when the S-wave amplitude dominates the equations, all higher partial waves being small. The requirement that the equations have consistent solutions without bound states turns out to limit the pion-pion coupling constant to the range $-0.46 < \lambda \lesssim 0.03$. Results are given for various values of λ within this interval. (Contractor's abstract)

254

California U. Dept. of Physics, Berkeley.

X-RAY YIELDS FROM μ-MESONIC ATOMS, by M. A. Ruderman. Dec. 1959 [38]p. incl. diagrs. tables. refs. (AFOSR-TN-60-118) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)327 and National Science Foundation) AD 233715; PB 146745 Unclassified

Also published in Phys. Rev., v. 118: 1632-1641, June 15, 1960.

The interesting suggestion was made that the rapid drop in the yield of K x-rays in the light elements may be associated with the capture of μ-mesons into the metastable 2s-state. The mechanisms for making transitions from the 2s to the 1s state and from various p-states into the 2s state were investigated in detail for Li, Be and B. It is found that the paradoxical reduction of K x-rays remains unexplained. (1) Stark mixing of the mesonic 2s and 2p states by the electric fields of the atomic electrons allows "mixed" Auger-radiative transitions to the 1s state to compete favorably with radiationless transitions. These mixed transitions give a high-energy x-ray and a relatively negligible (10 - 50 ev) electronic excitation and so contribute to the observed K_α yield. (2) Even if the above "mixed" transitions are ignored, there is no mechanism which gets a large fraction of μ-mesons into the 2s state that at the same time does not violently contradict both theoretical estimates and observed K x-ray yields from light π-mesonic atoms. (Contractor's abstract)

255

California U. Dept. of Physics, Berkeley.

DYNAMICAL CONSEQUENCES OF THE K^+ -K^0 MASS DIFFERENCE, by G. Frye. [June 26, 1960] 9p. incl. refs. (AFOSR-TN-60-323) (AF 49(638)327) AD 255780 Unclassified

Also published in Nuovo Cimento, Series X, v. 18: 282-286, Oct. 16, 1960.

The possibility of using the observed K^+ -K^0 mass difference for obtaining some information on the π + K interaction is investigated. The fraction of the total isotopic vector charge of the K-meson that resides in the two-pion cloud is the crucial parameter. It must have a value greater than unity in order to obtain a simple dynamical origin of the mass difference. Consistency requirements arising from the relation to π-K scattering imply that the fraction must have a value within the interval $-2 \lesssim f_K \lesssim 2$.

256

California U. Dept. of Physics, Berkeley.

UNITARITY CONDITION BELOW PHYSICAL THRESHOLDS IN THE NORMAL AND ANOMALOUS CASES, by S. Mandelstam. [1960] [4]p. incl. diagr. (AFOSR-TN-60-473) [AF 49(638)327] AD 243993 Unclassified

Also published in Phys. Rev. Ltrs., v. 4: 84-87, Jan. 15, 1960.

It is often the case with dispersion relations that the absorption part for positive energies extends below the physical threshold. When calculating the amplitude for these processes, the unitarity condition has to be used in the region $4\mu^2 < t < 4M^2$, and the question at once arises whether it is really valid here. The object of this report is to attempt to justify the use of the unitarity condition below the physical threshold, and to investigate how to modify it in the anomalous case. It is shown that the same treatment is applicable to the normal and anomalous cases. It is also shown that the unitarity condition as used is correct. The validity of dispersion relations for partial waves is assumed, and the unitarity condition in the physical region is approximated by taking only 2-particle intermediate states.

257

California U. Dept. of Physics, Berkeley.

THEORY OF THE LOW-ENERGY PION-PION INTERACTION. PART II, by G. F. Chew and S. Mandelstam. Mar. 24, 1960, 41p. incl. diagrs. (Rept. no. UCRL-9126) (AFOSR-TN-60-891) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)327 and Atomic Energy Commission) AD 258894 Unclassified

Also published in Nuovo Cimento, Series X, v. 19: 752-776, Feb. 16, 1961.

It is shown that when P-wave pion-pion scattering is large at low energies, the integral equations previously formulated (Phys. Rev., v. 119: 467, 1960) require a cut-off. Because of the cut-off and the unstable nature of the solution, the numerical integration procedure becomes much more involved. The original equations are therefore replaced by a series of conditions at the symmetry point, and the unphysical cuts of the partial-wave amplitudes are replaced by a corresponding series of poles. Within this framework one need not speak of

a cut-off, but one new parameter appears. Self-consistent solution can be found in which a P-wave resonance is sustained by a bootstrap mechanism; that is, a strong attractive force in the I = 1 state results from the exchange of a resonating pair of P-wave pions. The symmetry-point conditions used would be modified by the cut-off and quantitative accuracy is not attempted; however, this and other corrections are not expected to change the qualitative nature of our solutions. Rough estimates of the corrections are made. (Contractor's abstract)

258

California U. [Dept. of Physics] Berkeley.

EFFECT OF THE PION-PION RESONANCE OF K^--ρ SCATTERING, by F. Ferrari, C. Frye, and M. Pusterla. May 4, 1960, 12p. incl. diagrs. table, refs. (Rept. no. UCRL-6196) (AFOSR-TN-60-892) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)327], Atomic Energy Commision, and National Academy of Science) AD 256475 Unclassified

Also published in Phys. Rev. Ltrs., v. 4: 615-618, June 15, 1960.

The validity of the assumption that k cot δ is essentially constant and equal to the reciprocal (complex) scattering length in examining the nature of the basic K-meson nucleon interaction is discussed. It is found that the two-pion exchange, which determines the long-range tail of the K-N interaction, gives a substantial energy dependence to k cot δ. The contribution of the two-pion exchange to the $\bar{K}$-nucleon interaction is calculated.

259

California U. Dept. of Physics, Berkeley.

SOME EFFECTS OF HOLE-HOLE INTERACTIONS IN SYSTEMS OF FERMIONS, by J. Sawicki. [1960] 17p. incl. refs. (AFOSR-TN-60-893) (AF 49(638)327) AD 243994; PB 153032 Unclassified

Also published in Nuovo Cimento, Series X, v. 17: 893-901, Sept. 1960.

A generalized reaction matrix of the Brueckner theory is discussed involving the effects of hole-hole interactions in large systems of fermions. Corrections to the real part of the single particle excitation energy are estimated for the cases of nuclear matter and liquid He^3. The problem of the damping factor (i.e., the imaginary energy shift) is discussed. (Contractor's abstract)

260

California U. Dept. of Physics, Berkeley.

SPIN AND PARITY ANALYSIS FROM PRODUCTION AND DECAY OF HYPERON RESONANT STATES, by R. Gatto and H. P. Stapp. [1960] 9p. (AFOSR-244) (Sponsored jointly by Air Force Office of Scientific Research and Atomic Energy Commission under AF 49-(638)327; and Office of Naval Research under Nonr-22260) Unclassified

Also published in Phys. Rev., v. 121: 1553-1555, Mar. 1, 1931.

Evidence for a pion-hyperon resonant state with a mass of about 1.37 bev was reported recently. Methods are discussed for determining from angular correlations in the production and decay of this resonant state, which we call lambda, sigma, Y, and K. (Contractor's abstract)

261

California U. Dept. of Physics, Berkeley.

THE GREEN'S FUNCTION METHOD AND SUPERCONDUCTIVITY OF SYSTEMS OF FERMIONS, by J. Sawicki. [1960] 23p. incl. refs. (AFOSR-245) (AF 49(638)327) AD 255778 Unclassified

Also published in Ann. Phys., v. 13: 237-249, May 1961.

The method of Green's functions in the theory of many fermion systems has been recently developed by Gorkov and Migdal for the case of superconduction systems. Some further applications of their formalism are given for zero- and for finite temperatures. The pair distribution function of a superconducting system of fermions is calculated by this method. The perturbation theory for impurities in superconductors described by one-particle operators is further discussed. The problem of residual two-body forces in a superconducting system is discussed. A reaction matrix-type treatment of such forces corresponding to a "ladder approximation" perturbation theory is indicated. (Contractor's abstract)

262

California U. [Dept. of Physics] Berkeley.

IMAGINARY PART OF THE OPTICAL MODEL POTENTIAL IN NUCLEAR MATTER, by J. Sawicki and S. A. Moszkowski. [1960] [6]p. incl. table (AFOSR-876) (AF 49(638)327) AD 255438 Unclassified

Published in Nuclear Phys., v 21: 456-461, Dec. 1960.

The imaginary part of the optical model potential in nuclear matter has been calculated for various values of the energy, assuming Gammel-Thaler nucleon-nucleon interactions. The calculations were made using

the separation method in which the interaction is separated into a short range and long range part, the former giving zero phase shift. To a good approximation, only the long range component contributes to the imaginary part of the optical potential.

263

California U. [Dept. of Physics] Berkeley.

SPECTRAL REPRESENTATIONS FOR LARGE MOMENTUM TRANSFER IN PERTURBATION THEORY (Abstract), by R. Karplus and J. Tarski. [1960] [1]p. [AF 49(638)327] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 50, Jan. 27, 1960.

Spectral representations, or dispersion relations, are discussed within the framework of perturbation theory. In case of the fourth order, a detailed analysis of the amplitude as a function of two complex invariants can be applied advantageously. If there are no anomalous thresholds, then the singularities which are associated with Mandelstam's spectral functions do not prevent the analytic continuation of spectral representations to arbitrarily large space-like momentum transfers. If there are anomalous thresholds then spectral representations are valid for space-like momentum transfers except possibly for a finite interval of the momentum transfer variable, but only limited analytic continuation in momentum transfer is possible.

264

California U. [Dept. of Physics] Berkeley.

K^+-K^0 MASS DIFFERENCE IN LOCAL FIELD THEORY (Abstract), by G. Frye. [1960] [1]p. [AF 49-(638)327] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 51, Jan. 27, 1960.

It has been suggested that the negative sign of the K^+-K^0 mass difference can be attributed to a distribution of charge in the K^0. If the electromagnetic form factor is decomposed into (normalized) isotopic scalar and vector parts, the mass difference depends on their product. To obtain the observed sign, the product must change sign and remain negative over a substantial range of momentum transfer. Unitarity and the Mandelstam representation are used to express the spectral function of the vector part as a product of the pion electromagnetic form factor and the matrix element for $\pi + \pi \rightarrow K + \bar{K}$. The proposed resonance in π-π scattering suggests that the vector spectral function is very large at low frequencies and may therefore change sign at higher frequencies. We attempt to derive such a behavior by relating the vector spectral function to the π - K scattering amplitude. It appears that a p-wave resonance in both isotopic spin 1/2 and 3/2 channels is needed.

265

California U. [Dept. of Physics] Berkeley.

ANALYTICITY OF THE FOURTH ORDER SCATTERING AMPLITUDES WITH TWO COMPLEX INVARIANTS, by J. Tarski. [1960] [15]p. [AF 49(638)327] Unclassified

Published in Jour. Math. Phys., v. 1: 149-164, Mar.-Apr. 1960.

The partial Feynman amplitude corresponding to a particular fourth order diagram is examined as a function of energy and momentum transfer with both of these variables complex. The region of regularity of this function is found, and the types of singularities at the remaining points are determined. An approach which requires only elementary calculations is indicated. The condition of the validity of Mandelstam's representation in the fourth order is obtained. Spectral representations for exchange scattering processes at fixed momentum transfer are discussed as another application of the principle results.

266

California U. Dept. of Physics, Berkeley.

POSSIBLE CORRECTIONS TO NUCLEAR MAGNETIC MOMENTS DUE TO PAIRING FORCES IN NUCLEI. I, by J. Sawicki. [1960] [4]p. [AF 49(638)327] Unclassified

Published in Progr. Theoret. Phys., v. 24: 213-216, July 1960.

The possibility of an enhancement of the magnetic energy of an even-even nucleus in the constant magnetic field H (oriented along the z-axis) due to the BCS-type (Bardeen-Cooper-Schrieffer) pairing force is examined. The direct particle contributions to the magnetic moments turns out to be practically - if not exactly - zero. The collective contribution of the rotational motion of the nucleus as a whole characterized by the gyromagnetic ratio g_R-the coefficient of the rotational angular momentum R in the general expression μ is not considered and will be the subject of a latter publication.

267

California U. [Dept. of Physics] Berkeley.

LONG-RANGE INTERACTION IN $\bar{K}$-NUCLEON AND K-NUCLEON ELASTIC AMPLITUDES, by F. Ferrari, G. Frye, and M. Pusterla. [1960] [7]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)327], Atomic Energy Commission and National Academy of Science) Unclassified

Published in Phys. Rev., v. 123: 308-311, July 1, 1961.

A method of calculating, for the K-nucleon interaction, the long-range force arising from the exchange of a pion pair and of a possible 3-pion resonance state is formulated. It is shown that the long-range force can be related with the electromagnetic structure parameters of the nucleon and $\underline{K}$ meson. Finally, relations between K-nucleon and $\bar{K}$-nucleon elastic amplitudes are discussed. (Contractor's abstract)

268

California U. [Dept. of Physics] Berkeley.

ENERGY DEPENDENCE OF THE LOW-ENERGY K^--PROTON AND K^+-PROTON CROSS SECTIONS, by F. Ferrari, G. Frye, and M. Pusterla. [1960] [6]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)327], Atomic Energy Commission, and National Academy of Science) Unclassified

Published in Phys. Rev., v. 123: 315-320, July 1, 1961.

The K^--proton and K^+-proton S-wave scattering is analyzed by using a relativistic effective-range formula derived by studying the analytic properties of partial-wave scattering amplitudes. The influence of the pion-pion interaction on the elastic scattering and reaction cross section is discussed. (Contractor's abstract)

269

California U. [Dept. of Physics] Berkeley.

NUCLEAR SPIN OF LUTETIUM-177 (Abstract), by F. R. Petersen and H. A. Shugart. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)339] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 273, Apr. 25, 1960.

The nuclear spin I = 7/2 for radioactive lutetium -177 ($T_{1/2}$ = 7 days) has been measured in the electronic state $^2D_{5/2}$ by the atomic beam magnetic resonance method. The low-frequency "flop-in" resonances which were observed correspond to the transitions, F, m_F = 6, -3 ↔ 6, -4 and F, m_F = 5, -2 ↔ 5, -3. Nine such resonances have been observed at fields from 24 to 210 gauss. The quadratic and higher ordered shifts observed in these resonances have yielded preliminary values for the interaction constants a and b. The radioactive isotope was produced from the stable metal by the reaction $Lu^{176}(n,\gamma)Lu^{177}$ in the Livermore pool-type reactor. Purity of the radioactive isotope was established from pulse-height analysis of the gamma-ray spectrum. Resonance detection was accomplished by collecting the radioactive atoms on sulfur-coated "buttons" which were later counted in continuous flow beta-counters.

270

California U. [Dept. of Physics] Berkeley.

NEUTRON ACTIVATION DETECTION OF STABLE ISOTOPES IN ATOMIC-BEAM RESEARCH (Abstract), by H. A. Shugart and V. J. Ehlers. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)339] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 343, June 15, 1960.

A new method for atomic beam detection of stable isotopes has been developed and tested on Au^{197}. The stable atomic beam is collected on thin reactor-grade graphite sheets. The deposited atoms and graphite backing are then bombarded with thermal neutrons to activate the stable beam material. Because of the low cross section and low abundance of C^{13} and the long half-life of the product C^{14}, the induced carbon activity will be small compared to the activity induced in fractional microgram quantities of the deposited beam substance. Great care must be exercised in preparing the graphite collectors to prevent contamination. Feasibility of the method was demonstrated by observing atomic beam resonances in Au^{197} and verifying its known spin of 3/2. After activation, the samples were counted in continuous-flow Geiger counters and with a γ-ray pulse height analyzer. The decay curve of each sample served to establish the activated Au^{198} (2.7d) content. This method should prove useful for many stable isotopes which have reasonable neutron capture cross sections and convenient reaction product half-lives.

271

California U. [Dept. of Physics] Berkeley.

NUCLEAR SPIN OF LANTHANUM-140 (Abstract), by F. R. Petersen and H. A. Shugart. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)339] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 343, June 15, 1960.

The nuclear spin I = 3 for radioactive lanthanum-140 ($T_{1/2}$ = 40 hr) has been measured in both the $^2D_{3/2}$ and the $^2D_{5/2}$ electronic states by the atomic beam magnetic resonance method. The low-frequency "flop-in" resonances which were observed at low magnetic fields correspond to the transition F,m_F = 9/2, -5/2 ↔ 9/2, -7/2 in the $^2D_{3/2}$ state and to the transition F,m_F = 11/2, -5/2 ↔ 11/2, -7/2 in the $^2D_{5/2}$ state. The radioactive isotope was produced from the stable metal by the reaction La^{139} (n,γ) La^{140} in the Livermore pool-type reactor. Resonance detection was accomplished by collecting the radioactive atoms on sulfur-coated "buttons" which were later counted in continuous flow beta counters.

272

California U. [Dept. of Physics, Berkeley].

A SUMMARY OF THE PUBLISHED SPIN AND HYPERFINE-STRUCTURE MEASUREMENTS AT THE UNIVERSITY OF CALIFORNIA FROM APRIL 1959 TO OCTOBER 1960, by H. A. Shugart. [1960] [2]p. incl. tables. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)339], Atomic Energy Commission, National Science Foundation, and Office of Naval Research) Unclassified

Presented at Fifth Brookhaven Conf. on Molecular Beams, Nov. 1960.

Tables of atomic and nuclear properties which have been published by the atomic beam group at this Institution. The verified measurements are indicated and the errors in the least significant digits are also pointed out. The author is indicated but the place of publication is not included.

273

California U. [Dept. of Physics] Berkeley.

ATOMIC BEAM STUDY OF THE HYPERFINE STRUCTURE OF THULIUM-170, by A. Y. Cabezas and I. Lindgren. [1960] [6]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)339], Atomic Energy Commission, Office of Naval Research, and Swedish Atomic Energy Commission) Unclassified

Published in Phys. Rev., v. 120: 920-925, Nov. 1, 1960.

The atomic-beam magnetic-resonance technique has been used to measure atomic and nuclear quantities of the 129-day isotope Tm^{170} as follows: J = 7/2, g_J = 1.14122 ± 0.00015, I = 1, |A| = 200 ± 3 mc/sec, and |B| = 1010 ± 15 mc/sec. The values of J and g_J are consistent with the ground-state assignment $^2F_{7/2}$. Values of the nuclear moments are calculated from the hyperfine-structure interaction constants A and B by use of a two-parameter radial wave function, in which one parameter is determined from comparison with Hartree functions and the other parameters from the experimental spin-orbit coupling constant. Uncorrected values are obtained, as follows: $|\mu_I|$ = 0.26 ± 0.02 nm and |Q| = 0.61 ± 0.05 barn, with the two moments of the same sign. The same wave function is used to calculate the relativistic and diamagnetic corrections to the atomic g value, and the result is in excellent agreement with the experiment. (Contractor's abstract)

274

California U. Dept. of Physics, Berkeley.

HYPERFINE STRUCTURE AND MOMENTS OF YTTRIUM-90 (Abstract), by F. R. Petersen and H. A. Shugart. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)339] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., California U., Berkeley, Dec. 29-31, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 504, Dec. 29, 1960.

The hyperfine structure separations for radioactive yttrium-90 ($T_{1/2}$ = 64 hr) have been measured in both the $^2D_{3/2}$ and $^2D_{5/2}$ electronic states by the atomic beam magnetic resonance method. The spin I = 2 has been previously reported. Eleven "flop-in" transitions in the $^2D_{3/2}$ state and 10 "flop-in" transitions in the $^2D_{5/2}$ state corresponding to the high field transition $M_J = \pm 1/2 \leftrightarrow \mp 1/2$ have been observed. The interaction constants a and b fitted to these observations are $a(^2D_{3/2})$ = - 169.749(15) mc/sec, $b(^2D_{3/2})$ = - 21.602(60) mc/sec, $a(^2D_{5/2})$ = - 85.258(15) mc/sec, $b(^2D_{5/2})$ = - 29.716(60) mc/sec. The uncorrected nuclear magnetic

moment calculated from the hyperfine structure using the magnetic moment and interaction constants of Y^{89} is μ_I = - 1.623(8) n.m. The sign of the moment was determined from the g_I- dependent $\Delta F = \pm 1$ transitions for which the magnetic field dependence was zero at high fields. The uncorrected nuclear electric quadrupole moment calculated from the interaction constant b for both electronic states is Q = 0.15(2) barn.

275

California U. [Dept. of Physics] Berkeley.

THE MOTION OF CHARGED PARTICLES IN A RANDOM MAGNETIC FIELD, by J. A. Crawford. July 27, 1960. 18p. incl. refs. (AFOSR-205) [AF 49-(638)508] AD 255779 Unclassified

Also published in Proc. Fourth Berkeley Symposium on Mathematical Statistics and Probability, California U., Berkeley (June 20-July 30, 1960), Los Angeles, California U. Press, 1961, v. 3: 1-10. (AFOSR-2135)

Three postulates are assumed for the problem: (1) For L, a characteristic length associated with the fluctuations of the magnetic field and l, a characteristic length associated with a given particle, $l/L << 1$; (2) The velocity field for the plasma in which the magnetic field is embedded is small compared with the particle velocity; (3) The component $V_\perp$ of the particle velocity normal to the magnetic field is small compared with c. The equations of motion are linearized with respect to $V_\perp/c$. A simple linearized equation of motion, $\frac{d\theta}{ds} = K$, is derived. Since this equation is integrable, a Fokker-Planck equation can be derived for probability distribution of θ. This equation is shown to reduce to $\frac{\partial B}{\partial s} = \varphi \frac{\partial^2 P}{\partial \theta^2}$, $\varphi > 0$, constant.

276

California U. Dept. of Physics, Berkeley.

EFFECTS OF THE PAULI PRINCIPLE ON THE SCATTERING OF HIGH-ENERGY ELECTRONS BY ATOMS, by M. H. Mittleman and K. M. Watson. [1960] [12]p. incl. table. (AFOSR-206) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)508 and Atomic Energy Commission) AD 255781 Unclassified

Also published in Ann. Phys., v. 10: 268-279, June 1960.

Some consequences of the Pauli principle for the elastic scattering of electrons by atoms are studied. The contributions both from the exchange integrals and from the Hartree-Fock condition that the scattered wave functions are expressed in a simple approximation form. For high-energy electrons these corrections are very small. (Contractor's abstract)

277

California U. Dept. of Physics, Berkeley.

QUANTUM MECHANICAL TRANSPORT THEORY. I. INCOHERENT PROCESSES, by K. M. Watson. [1960] [13]p. incl. diagrs. refs. (AFOSR-207) [AF 49(638)508] AD 255782 Unclassified

Also published in Phys. Rev., v. 118: 886-898, May 15, 1960.

The transport of particles through a scattering medium is studied. A generalization of a technique due to Placzek and Wick is used to handle sums over states of excitation of the medium. The collision processes which occur are classified as "inelastic," "elastic," and "quasi-elastic" and correspond to different orderings of the Placzek-Wick series. The inelastic scatterings are described by an essentially classical transport equation and the elastic scatterings by assigning a refractive index to the medium. The "quasi-elastic" scattering involves the excitation of low-lying states of the scattering system. The coherent interference of waves scattered from nearby scatterers is important in this case and depends upon the structure of the medium. The general theory is developed in terms of a systematic sequence of approximations, of which the first gives just the classical form of transport theory. The correction terms then appear as quantum-mechanical corrections to the classical transport problem. (Contractor's abstract)

278

California U. [Dept. of Physics] Berkeley.

LINKED-DIAGRAM EXPANSION FOR THE EQUATION OF STATE OF A GAS OF MOLECULES, by A. N. Kaufman and K. M. Watson. Oct. 10, 1960 [29]p. incl. diagrs. (AFOSR-633) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)508 and Atomic Energy Commission) Unclassified

Also published in Phys. Fluids, v. 4: 655-662, June 1961.

The method of the linked-diagram expansion is applied to the equilibrium statistical mechanics of a nondegenerate gas of molecules, taking into account the structure of the molecules, and using the Pauli principle for all the electrons. Molecular interactions, including the effects of exchange, are thus obtained from first principles.

279

California U. Dept. of Physics, Berkeley.

CYCLOTRON RESONANCE IN METALS - EXPERIMENTAL, by A. F. Kip. [1960] [8]p. incl. diagrs. refs. (AFOSR-3410) (AF 49(638)600) Unclassified

Also published in Proc. Internat'l. Conf. on the Fermi Surface of Metals, Cooperstown, N. Y. (Aug. 22-24, 1960), New York, Wiley and Sons, 1960, p. 146-153. (AFOSR-395)

Azbel'-Kaner type cyclotron resonance experiments have given information on effective masses of electrons in tin, lead, aluminum, bismuth, and copper. The most detailed studies have been in copper. In this paper the results in copper will be used to illustrate the importance of several experimental parameters in identifying various types of orbits. These parameters include tipping of the magnetic field at small angles relative to the metal surface, and adjustment of the rf electric field either parallel or perpendicular to the magnetic field. Phase shift of the cyclotron harmonics will be discussed. New data on copper include values for the cyclotron mass of the belly orbit, the dog's bone orbit, a double mass orbit, and an orbit which is tentatively identified as the neck orbit. Results are consistent with the general shape of the Pippard model for the Fermi surface in copper. (Contractor's abstract)

280

California U. Electronics Research Lab., Berkeley.

ON THE CHARACTERISTIC FREQUENCIES OF LOSSLESS NONRECIPROCAL NETWORKS, by C. A. Desoer. [1958] 4p. (AF 18(600)1521) Unclassified

Also published in I.R.E. Trans. on Circuit Theory, v. CT-5: 374-375, May 1958.

Given an arbitrary linear lumped time invariant network made of capacitances, inductances (including mutual inductances) and gyrators it is physically obvious that any set of initial conditions can only cause waveforms of the form $A_k \cos(\omega_k t - \varphi_k)$. The purpose of this note is to furnish an algebraic proof of this theorem. It is pointed out that one might think that in the case of multiple roots, that solutions of the form $t^m \cos(\omega_k t - \varphi k)$, with m a positive integer, would occur. This is ruled out.

281

California U. Electronics Research Lab., Berkeley.

AN OPTIMAL STRATEGY FOR A SATURATING SAMPLED-DATA SYSTEM, by C. A. Desoer and J. Wing. Dec. 15, 1959, 40p. incl. diagrs. tables. (Series no. 60; issue no. 262) (AFOSR-TN-60-67) (AF 18(600)-1521) AD 233739; PB 146361 Unclassified

Also published in I.R.E. Trans. on Automatic Control, v. AC-6: 5-15, Feb. 1961.

The problem of finding, proving, and implementing the optimal strategy for the sampled-data servo is discussed. A second-order linear servomechanism is considered. The optimal control signal for this system may be obtained by a simple method using standard analog computer techniques. A formulation is presented of the problem that requires the minimum number of parameters. The set of all possible initial states is partitioned into sets, R_N, in terms of the minimum number of sampling periods required to reach equilibrium. Theorems are presented which establish the exact shape of these sets. The optimal strategy is shown to be unique for special initial states. The optimality of the proposed strategy is established and implemented. The relationship between the optimal strategy for the sampled system and the optimal relay solution for the corresponding continuous system is discussed.

282

California U. Electronics Research Lab., Berkeley.

OPERATIONAL ANALYSIS OF FINITE-PULSED SAMPLED-DATA SYSTEMS, by T. Nishimura. May 10, 1960, 37p. incl. diagrs. (Series no. 60; issue no. 279) (AFOSR-TN-60-510) (AF 18(600)1521) AD 239900; PB 149092 Unclassified

Also published in I.R.E. Trans. on Automatic Control, v. AC-6: 344-346, Sept. 1961.

The theory of the operational analysis of the finite-pulse-width system is developed in this report. The closed-form expression of the response from such system is described by means of several well-known operators such as the z-transform, the modified z-transform and the simple form of the p-transform. Finding the incremental responses and their superposition is the basic principle of the theory and it is also applied to two-sampler systems as well as multi-rate sampling systems. (Contractor's abstract)

263

California U. Electronics Research Lab., Berkeley.

ON THE SUMMATION OF $\sum_{n=0}^{\infty} \frac{f_n}{n^k}$ AND ITS ASSOCIATED INTEGRALS, by E. I. Jury and M. A. Pai. Sept. 14, 1960, 21p. incl. diagrs. refs. (Series no. 60; issue no. 315) (AFOSR-TN-60-1145) (AF 18(600)1521) AD 246763; PB 153313 Unclassified

Also published in Jour. Franklin Inst., v. 271: 79-93, Feb. 1961.

A geometrical interpretation of the convolution z transform is given. This is applied to develop z transforms of functions of the type $f(t)/t^k$, $k > 0$. After establishing the equivalence between certain forms of integrals, the integrals were used to sum certain forms of infinite series. Possible extensions of this technique to other forms of series and to sum finite series is also indicated. (Contractor's abstract)

284

California U. Electronics Research Lab., Berkeley.

ON THE PERIODIC MODES OF OSCILLATIONS IN PULSE-WIDTH-MODULATED FEEDBACK SYSTEMS, by E. I. Jury and T. Nishimura. Nov. 29, 1960, 62p. incl. diagrs. refs. (Series no. 60; issue no. 328) (AF-OSR-TN-60-1474) (AF 18(600)1521) AD 250343; PB 154363 Unclassified

A general procedure for obtaining information on the periodic modes of oscillation in PWM and nonlinear sampled-data feedback systems is considered. Based on the equivalence of PWM in the state of limit cycles to the finite pulsed systems with the periodically varying sampling pattern, the methods of analysis applied to the latter are extended to obtain these limit cycles. In particular, the final value theorem is applied to obtain the fundamental response equation which gives rise to the limit cycles for the various specified modes. The theory is applied to systems with and without integrator and the results are checked by the phase-phane approach. Three kinds of nonlinearities, namely, pulse-width modulation, relay, and saturating gain, are discussed among the various nonlinearities, and examples are presented for each of these cases. Both self-excited and forced oscillations are examined as well as the possible existence of limit cycles for certain specified modes. This approach to examining the periodic modes is not restricted to the type of nonlinearity or the order of the systems. However, it is based on the assumption that the mode of the limit cycle is specified as can be done in certain cases, and thus the method of this paper permits the study of the conditions that sustain those oscillations. (Contractor's abstract)

285

California U. Electronics Research Lab., Berkeley.

MINIMAL-TIME DISCRETE SYSTEM, by C. A. Desoer and J. Wing. Nov. 15, 1960, 48p. incl. diagrs. refs. (Series no. 60; issue no. 327; AFCRL-111) (AFOSR-30) (Sponsored jointly by Air Force Cambridge Research Labs. as Scientific rept. no. 4 under AF 19-(604)5466 and Air Force Office of Scientific Research under AF 18(600)1521) AD 254012; PB 155629 Unclassified

Also published in I.R.E. Trans. on Automatic Control, v. AC-6: 111-125, May 1961.

Abstract published in Joint Autom. Control Conf., A Digest of Papers, Colorado U., Boulder (June 28-30, 1961), New York, L. Winner, 1961, p. 26.

A sampled-data control system in which the forward path consists of a sampler with period T, a zero-order hold circuit, a liner amplifier and a plant with transfer function $G(s) = I/\sum_{i=1}^{n} (s - \lambda_i)$ is investigated. The problem is to find the forcing function f(t), satisfying $|f(t)| \leq 1$, and the corresponding computer to be placed in the feedback loop which will bring the system to equilibrium in the minimum number of sampling periods. This problem was solved by first determining the R'_N of state space points from which the origin can be reached in N sampling periods or less and then by obtaining a unique canonical representation of all points in R_N, the set of state space points from which the origin can be reached in N sampling periods and no less.

286

California U. Electronics Research Lab., Berkeley.

DESIGN OF LOSSY FILTERS BY DIGITAL COMPUTER, by S. K. Mitra and C. A. Desoer. Dec. 22, 1960, 37p. incl. diagrs. tables, refs. (Series no. 60; issue no. 338) (AFOSR-201) (AF 18(600)1521) AD 253175; PB 155360 Unclassified

Also published in I.R.E. Trans. on Circuit Theory, v. CT-9: 192-201, Sept. 1961.

Non-availability of ideal elements is a major drawback in the development of filters having some prescribed characteristic. In this paper, a method for designing lossy filters built with elements having unequal dissipation factors using a high-speed digital computer as the main tool is presented along with the results of a preliminary study of the method. The magnitude function, within the first order, is shown to be a multilinear function of the element values for very small change in the element values. The basic idea is to perturb the element values of lossy filter with the aim of making the magnitude function of the lossy filter proportional to that of the ideal filter. An error function is defined as the sum of squared differences between the magnitude characteristic of the lossy filter and the same of the ideal filter (multiplied by a suitable constant factor) at some discrete frequencies in the pass-band and the stop band. The error function is then minimized by the steepest descent method of minimization. Results of using the suggested method in designing a lossy Chebyshev filter of degree 9 are included. It is found that the minimization of the pass-band ripple is associated with a decrease in the stop-band attenuation. The paper also includes details on programming methods. (Contractor's abstract)

287

California U. Electronics Research Lab., Berkeley.

STABILITY OF NONLINEAR SAMPLED-DATA CONTROL SYSTEMS, by S. Kodama. Dec. 20, 1960, 26p. incl. diagrs. (Series no. 60; issue no. 336) (AFOSR-270) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1521 and National Science Foundation) AD 254693; PB 155806 Unclassified

With regard to the asymptotic stability in the large of nonlinear autonomous sampled-data control systems, the following conjecture has frequently appeared and has been used as a criterion for system design in the literature. Namely, "If the linearized system is stable for all points of the state space, the original nonlinear system is asymptotically stable in the large (a. s. i. l.)." This paper shows by counter examples, using a simple garden-variety position servo with a nonlinearity typical of those ordinarily encountered in practice, that the statement is not true in general. Both total and incremental linearizations are considered and in both cases the conjecture is false. Finally, a sufficient condition for a. s. i. l. is established.

288

California U. [Electronics Research Lab.] Berkeley.

ANALYSIS OF FINITE PULSE SYSTEMS WITH A PERIODICALLY VARYING SAMPLING RATE AND PULSE WIDTH, by E. I. Jury and T. Nishimura. [1960] 25p. incl. tables, refs. (AFOSR-3919) (AF 18-(600)1521) Unclassified

Presented at Summer General meeting of Amer. Inst. of Electrical Engineering, Atlantic City, N. J., June 19-24, 1960.

A general method for analysis of finite pulse width systems with periodically varying sampling rate (cyclic) is presented. In the limiting case, when $h_i \to T_i$, the continuous system is reached and when the sampling pattern has only one period, this becomes the case of the so-called p-transform system. When $h \to 0$ with infinite increase of gain of the system, the z-transform case will be obtained. Extension of this method to the multiple sampler is also possible. Furthermore, the method is useful for the analysis of certain pulse modulated feedback systems whereby the pulse duration follows a certain pattern. The application of the method for systems with pulse width modulator which is essentially non-linear is suggested. The approximate analysis of continuous system and the numerical analysis of differential equation are also amenable and further investigation along these lines is indeed warranted. (Contractor's abstract)

289

California U. Electronics Research Lab., Berkeley.

DISCUSSION ON A GENERAL FLOW GRAPH TECHNIQUE FOR THE SOLUTION OF MULTILOOP SAMPLED SYSTEMS, by G. G. Lendaris. [1960] [14]p. incl. diagrs. (AF 18(600)1521) Unclassified

A discussion is presented on a previously published article by Ash, Kim, and Kranc (item no. 383, Vol. III), which shows an efficient technique that the authors suggested could be achieved. In general it is found that the topological method is more efficient than the algebraic formula method. The former method takes advantage of the fact that the system determinant contains some zero terms before the calculations are made. A procedure is proposed for transforming the block-diagram representation of the system into its efficient sampled-signal-flow graph representation. The procedure is then applied to some of the examples given in the paper.

290

California U. [Electronics Research Lab.] Berkeley.

A NOTE ON THE STEADY-STATE RESPONSE OF LINEAR TIME-INVARIANT SYSTEMS TO GENERAL PERIODIC INPUTS, by E. I. Jury. [1960] [3]p. incl. diagrs. [AF 18(600)1521] Unclassified

Published in Proc. Inst. Radio Engineers, v. 48: 942-944, May 1960.

A simple procedure is presented for obtaining the steady-state response of linear systems to non-sinusoidal periodic inputs. This procedure is based on applying the final value theorem to the modified z-transform of the output. Two cases are discussed in which the final value theorem is applied. In case 1, $C(s) = F(s) + C_1(s) \frac{1}{1 - e^{-Ts}}$ where F(s) is a rational function of s and has a final value f_{ss} that can be obtained from $\lim_{s \to 0} sF(s)$. In case 2, $C(s) = F_i(s) \frac{F_2(e^{\tau_n s})}{1 - e^{-Ts}} = C_1(s) \frac{1}{1 - e^{-Ts}}$ where the sum of all τ_n is less than T. In addition 2 examples are given in reference to case 2 to indicate that mathematically, due care should be exercised in observing the convergence of the integral along the infinite semicircle in evaluating the modified z-transform.

291

California U. Electronics Research Lab., Berkeley.

CONTRIBUTION TO THE MODIFIED Z-TRANSFORM THEORY, by E. I. Jury. [1960] 17p. (AF 18(600)1521) Unclassified

Also published in Jour. Franklin Inst., v. 270: 114-129, Aug. 1960.

In this discussion, a useful theorem applied to the modified z-transform is introduced and verified. This theorem is fairly general and covers a few special cases that found many applications in the study of pulsed-systems. The applications of the theorems for various fields such as sampled data systems, digital control systems, circuit theory and to the operational solution of difference equations both linear and non-linear, are possible using the techniques of this paper. It is of particular importance that the extension of the convolution integral for solving certain types of non-linear difference equations is warranted.

292

California U. Electronics Research Lab., Berkeley.

BEHAVIOR OF A FIELD-SWEPT MASER OSCILLATOR, by J. C. Kemp. Apr. 19, 1960, 29p. incl. illus. diagrs. tables, refs. (Series no. 60; issue no. 275) (AFOSR-TN-60-509) (AF 49(638)102) AD 239720; PB 149239 Unclassified

The behavior of the radiation field arising in field-swept two-level maser oscillation, was discussed and the amplitude-modulation pattern was predicted under the conditions when the modulation should be most pronounced. The experimental waveforms presented corresponded satisfactorily with prediction.

293

California U. Electronics Research Lab., Berkeley.

ELECTRON SPIN RESONANCE IN NEUTRON-IRRADIATED CALCITE, by J. C. Kemp. July 5, 1960, 5p. incl. diagrs. (Series no. 60; issue no. 293) (AFOSR-TN-60-601) (AF 49(638)102) AD 242247 Unclassified

Also published in Jour. Chem. Phys., v. 33: 1269-1270, Oct. 1960.

Three crystals of natural calcite of weight about one gram each were given total dosages of 10^{17}, 10^{18}, and 10^{19} neutrons, respectively; a brownish coloration resulted, the most heavily dosed sample being almost opaque. The intensities of lines in the spin resonance spectrum increased roughly linearly and uniformly with neutron dosage. The main features of the spectrum seen were: (1) three strong equal-intensity lines, called the A-lines, located within some five gauss of the free-electron H_0 level in the spectrum; and (2) at least twelve lesser lines of intensities some one-fifth that of the A-lines, located within about 50 gauss of the free electron value on the low field ($g > 2$) side. Additional weaker lines were also seen. It is likely that several kinds of centers are present in this material. The three-fold multiplicity of the sets ABCDX, and the symmetries displayed by members of each set, are undoubtedly connected with the crystal symmetry. The present centers show no tendency to bleach out when the crystals are stored at room temperature for several months.

294

California U. Electronics Research Lab., Berkeley.

TRANSIENT BEHAVIOR OF AN ELECTRON STREAM AT AND BEYOND LIMITING CURRENT, by W. B. Bridges and C. K. Birdsall. Interim rept. Aug. 2, 1960, 26p. incl. diagrs. (Series no. 60; issue no. 303) (AF 49(638)102) AD 245968; PB 152931 Unclassified

Presented at I.R.E. Conf. on Electron Tube Research, Seattle, Wash., June 29-July 1, 1960.

This paper first reviews the classical dc solutions for a very broad electron stream, then adds new information on the dc solution for a thin stream; these steps are introductory to calculations of the process of changing from one state to the next, performed by detailed trajectory calculations. The new result is that beyond the critical value the behavior is not wholly dc, as was implied in the dc solutions, but consists of a large oscillatory motion of a potential minimum, with corresponding large ac current and velocity output. The fundamental period is roughly half a plasma cycle measured at the input plane, hence can be very short, easily ten to the minus nine sec. Brief mention is made of the relation of this behavior to that of the cathode potential minimum and shot-noise smoothing as dependent on frequency; also, the possibility of fast acting switches should be noted. (Contractor's abstract)

295

California U. Electronics Research Lab., Berkeley.

NOISE IN BACKWARD-WAVE AMPLIFIERS, by H. Jory. July 25, 1960, 168p. incl. diagrs. tables, refs. (Series no. 60; issue no. 298) (AFOSR-TN-60-1171) (AF 49-(638)102) AD 247353; PB 153400 Unclassified

The backward-wave amplifier, a type of traveling wave tube, is studied from the point of view of the current and velocity fluctuations which are present in the electron beam, and which produce electrical fluctuations or noise in the output of the device. The work is concerned with tubes employing the tape-helix interaction circuits and hollow cylindrical electron beams normally found in backward-wave amplifiers. An analysis is presented which demonstrates that this type of amplifier involves an infinite set of beam waves having one phase variation in angle, but different radial variations. An experimental system designed to measure that part of the noise which couples to the backward-wave amplifier is described. Measurements with two types of operating conditions

near the cathode are discussed. Measurements of noise power out of the helix are interpreted also in terms of a noise admittance on the beam. The experimentally-determined admittance is transformed back along the beam, toward the cathode, and compared with calculated values at the first anode and at the potential minimum. Measured values show good agreement with each other but not with the calculations. (Contractor's abstract)

296

California U. [Electronics Research Lab.] Berkeley.

MASER OSCILLATOR LINE SHAPES, by J. R. Singer. [1960] [5]p. (Series no. 60; issue no. 342) (AFOSR-53) (AF 49(638)102) AD 251738 Unclassified

Also published in Quantum Electronics, A Symposium, Highview, N. Y. (Sept. 14-16, 1959), New York, Columbia U. Press, 1960, p. 525-529.

Following the concept proposed by Bloembergen and Pound, the simple case of a set of spins acting as a permanent magnet is considered. By using a set of spins initially at a negative temperature (inverted spins), negligible line width and by having H_0 (static magnetic field) set to resonance the following equation is derived: $\theta + \frac{\theta}{2\tau} + \frac{1}{\tau\tau_r} \sin\theta = 0$), where θ = the angle between the spin vector and H_0, τ = the reaction time constant introduced by Bloembergen and Pound, and $\tau_r = 1/2$ the cavity ringing time. Such conditions are difficult to satisfy experimentally and more planning is needed to carefully compare theory and practice.

297

California U. Electronics Research Lab., Berkeley.

PARAMAGNETIC MASER OSCILLATOR ANALYSIS, by S. Wang and J. R. Singer. [1960] 16p. incl. diagrs. refs. (Series no. 60; issue no. 402) (AFOSR-2340) (AF 49(638)102) AD 275577 Unclassified

Also published in Jour. Appl. Phys., v. 32: 1371-1376, July 1961.

A physical and mathematical description of maser oscillator is given with emphasis upon explaining the structure of the output line shape. Several approaches to the problem are taken. A qualitative description of the motion of the spin vector is followed by a derivation of the equations pertinent to the interaction of a tuned circuit (microwave cavity) and precessing spins. The resultant equation is nonlinear. Approximate solutions are plotted as output amplitude vs time. In addition, the equations are solved with numerical solutions for specific experimental conditions by means of a digital computer. The numerical results are compared with experimental data. The field-swept oscillator line shapes are explained by the analysis, and the steady state oscillator is described. (Contractor's abstract)

298

California U. Electronics Research Lab., Berkeley.

A NEW AUTOMATIC FREQUENCY REGULATION SYSTEM, by J. R. Singer. [1959] [1]p. incl. diagr. (AFOSR-J65) [AF 49(638)102] Unclassified

Also published in I.R.E. Trans. on Microwave Theory and Tech., v. MIT-8: 249, Mar. 1960.

A system is described that was designed for stabilization of a VA-96 (K-band) klystron, but is readily applicable to any other voltage-tunable microwave source. The advantages of the system is that it is economical, easy to align and adjust, monochromatic in output, and its output is also isolated from its stabilization loop. It appears that the system is stable to better than 1 mc, and probably is stable to within 50 kc.

299

California U. [Inst. of Engineering Research] Berkeley.

APPARATUS FOR THE DETERMINATION OF THE BAND ABSORPTION OF GASES AT ELEVATED PRESSURES AND TEMPERATURES, by J. T. Bevans, R. V. Dunkle and others. [1959] [7]p. incl. diagrs. table. [AFOSR-2471] (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1570 and National Science Foundation) Unclassified

Also published in Jour. Opt. Soc. Amer., v. 50: 130-136, Feb. 1960.

Apparatus for the measurement of the band absorption of gases at pressures up to 10 atm and temperatures up to 1400°K is described. The distinguishing feature of the apparatus is the nozzle seal system which allows measurements to be made at wavelengths out to 23μ. An optical path of 15 in. is maintained with an accuracy of 1% by the nozzle seal system. However, the system does introduce uncertainties into the experimental measurements for which certain modifications are being made.

300

California U. [Inst. of Engineering Research] Berkeley.

ABSORPTION BY INFRARED BANDS OF CARBON DIOXIDE GAS AT ELEVATED PRESSURES AND TEMPERATURES, by D. K. Edwards. [1960] [10]p. incl. diagrs. tables, refs. [AFOSR-2472] (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)1570] and National Science Foundation) Unclassified

Also published in Jour. Opt. Soc. Amer., v. 50: 617-626, June 1960.

Experimental data and empirical correlations for the total absorption of band groups at 15, 10.4, 9.4, 7.5, 5.2, 4.8, 4.3, 2.7, 1.6, and 1.4μ are presented for carbon dioxide gas in nitrogen at total pressures from 0.5 to 10 atm, temperatures from 294° to 1390°K and mol fractions from 0.05 to 1.00. The data were obtained from low-resolution measurements of the spectral absorptivity. Use of optical paths of 129 cm at 294°K and 38.8 cm at that and higher temperatures resulted in a range of mass path lengths from 10 to 24,500 g/m^2. (Contractor's abstract)

301

California U. [Inst. of Engineering Research] Berkeley.

DEVELOPMENT AND STRUCTURE OF PLANE DETONATION WAVES, by A. K. Oppenheim and R. A. Stern. Feb. 1960 [125]p. incl. illus. diagrs. table, refs. (Technical note no. DR 7) (AFOSR-TN-60-124) (AF 49-(638)166) AD 233940; PB 146360 Unclassified

Also published in Combustion and Propulsion; Fourth AGARD Colloquium [1960], New York, Pregamon Press, 1961, p. 186-258.

The current status of knowledge on the development and structure of plane detonation waves is critically reviewed. A comprehensive historical survey is reported of the problem including contemporary studies, and the exposition of: (1) current theories concerning the mechanism of the development of the process, and (2) the analysis of the structure of the steady, plane detonation wave. (Contractor's abstract)

302

California U. [Inst. of Engineering Research] Berkeley.

PHOTOGRAPHIC OBSERVATION OF ACCELERATING FLAMES, by W. Baumann, P. A. Urtiew, and A. K. Oppenheim. July 1960 [44]p. incl. illus. diagrs. tables, refs. (Technical note no. DR 8) (AFOSR-TN-60-932) (AF 49(638)166) AD 244280 Unclassified

Streak photographs of the transition from slow-burning to detonation have been obtained by self-light photography of the flame using a rotating drum camera. Experiments were performed with stoichiometric hydrogen-oxygen mixtures contained in plastic tubes closed at one end and ignited by pilot flames. The investigation included the effect of tube diameter and distance of ignitor from closed end on the development of detonation. The plots of detonation induction distances and times as a function of tube diameter indicate the existence of asymptotes. Above a certain value of tube diameter there should be no further increase of induction distance and time with increasing tube diameter. A graph of average detonation induction velocity, that is, the ratio of average induction distance to time, shows that wall effects are noticeable only for tubes with a diameter smaller than about 1 cm. Maximum observed flame velocities, attaining the value of 3.1 km/sec, were observed immediately following the onset of retonation before the combustion front settles down to the Chapman-Jouguet detonation with a velocity of 2.8 km/sec. The plot of world lines on the log-log scale revealed that the development process can be bracketed between two asymptotes, one corresponding to an acceleration which decreases, or is sometimes even negative, and the other with acceleration that increases with time. The average value of observed accelerations was of an order of 10^6 m/sec^2. Photographs revealed interesting details of flow and wave patterns behind the flame front, and in particular the generation of a shock reflected from the closed end and its interaction with the accelerating flame. (Contractor's abstract)

303

California U. [Inst. of Engineering Research] Berkeley.

PROCEEDINGS OF FOURTH CONTRACTOR'S MEETING ON AIRBREATHING COMBUSTION, Berkeley, May 16-17, 1960. Oct. 1960, 16p. (AFOSR-TN-60-1253) (AF 49(638)166) AD 247033; PB 153448 Unclassified

The abstracts of the several papers presented at this contractor's meeting deal with various aspects of combustion such as the development of detonation, supersonic combustion, waves, fuel droplet interaction, and ions in flames.

304

California U. [Inst. of Engineering Research] Berkeley.

EXPERIMENTAL STUDY OF THE DEVELOPMENT OF DETONATION, by A. J. Laderman and A. K. Oppenheim. Nov. 1960, 1v. incl. illus. diagrs. tables, refs. (Technical note no. DR 9) (AFOSR-TN-60-1303) (AF 49-(638)166) AD 250661 Unclassified

The initial phase of flame acceleration during the development of detonation in stoichiometric hydrogen-oxygen mixtures, with particular emphasis on the generation of pressure waves at the flame front, was investigated. This was accomplished by means of streak self-light, streak schlieren, and flash schlieren photographs, together with simultaneous pressure measurement at several locations in the induction regime. Experimental records revealed considerable detail of the pressure wave ahead of the flame. They yield also evidence of the structure of the reaction zone, as well as information on the transition from a wrinkled laminar to a turbulent flame. Marked influence of the type of ignition, spark discharge, pilot flame, and glow coil, has been demonstrated. The flame acceleration and pressure history computations were in satisfactory agreement with experimental observation.

305

California U. [Inst. of Engineering Research] Berkeley.

PERFORMANCE ANALYSIS OF SHOCK TUBES WITH AREA CHANGE AT THE DIAPHRAGM SECTION, by A. K. Oppenhelm and P. A. Urtiew. Dec. 1960 [63]p. incl. diagrs. tables. (Technical note no. DR 10) (AFOSR-56) (AF 49(638)166) AD 253242 Unclassified

The determination of the wave pattern obtained in shock tubes with essentially a different cross section on the two sides of the diaphragm is considered. The analysis is performed by the use of the Vector Polar Method which yields information on the final wave pattern and the stationary states produced by it without considering the details of the wave generation processes. The results obtained for a perfect gas with constant specific heats are summarized on a chart coordinating area ratio with the diaphragm pressure ratio, from which the wave pattern obtained with any combination of these parameters can be read directly. The results cover the range of area ratios from 0.1 to 10 and diaphragm pressure ratios up to 150:1 for both the case of single area changes and that of a convergent-divergent nozzle at the diaphragm section. Included also is an illustrative problem of different gases on the two sides of the diaphragm. (Contractor's abstract, modified)

306

California U. [Inst. of Engineering Research] Berkeley.

FLAME IONIZATION DURING THE DEVELOPMENT OF DETONATION, by A. J. Laderman, G. J. Hecht and others. [1960] [8]p. incl. diagrs. table, refs. [AFOSR-2494] (AF 49(638)166) Unclassified

Also published in Eighth Symposium (Internat'l.) on Combustion, California Inst. of Tech., Pasadena (Aug. 28-Sept. 3, 1960), Baltimore, Williams and Wilkins Co., 1962, p. 199-206. (AFOSR-TR-60-127)

Considerations for the measurement of ionization in flames during the development of detonation in gases are reviewed. On the basis of preliminary theoretical and experimental investigations, an ion gap circuit was designed which responds to low flame ionization levels. One difficulty in this type of research is the problem of distinguishing between waves sensed by the ionization detector and interpreting the records in order to derive information about the fluctuating character of the propagation of the combustion front. The purpose of this research is to present ways of dealing with these problems in the case of the development of detonation in hydrogen-oxygen mixtures when the process is observed by means of ion gaps mounted flush with the wall. Analysis of the results revealed that scatter in arrival times at each probe interval is normally distributed, the distribution changing along the tube axis. Further, it was found that the scatter could be attributed only to a physical process yielding specific information on the fluctuating mode of flame propagation in the course of its acceleration to detonation.

307

California U. [Inst. of Engineering Research] Berkeley.

DEVELOPMENT OF DETONATION (Abstract), by A. K. Oppenheim and A. J. Laderman. [1960] [3]p. [AF 49(638)166] Unclassified

Presented at Fourth Contractor's Meeting on Air-breathing Combustion, California U., Berkeley, May 16-17, 1960. (AFOSR-TN-60-1253; AD 247033)

Observations by means of ionization signals and optical observations made during the development of detonation for the study of gas wave dynamics are reported. A study of velocity fluctuations in hydrogen-oxygen flame accelerating to detonation was made and the scatter in time of arrival was found normally distributed at an 85% probability level. The intensity of scatter was interpreted as indicative of the combustion front fluctuation that can be considered to delineate the effective flame thickness. It was found that as the flame accelerates, its thickness first increases and then decreases. By optical observations, a marked regime of flame deceleration was observed soon after ignition, followed by a period of rapidly increasing acceleration leading to the onset of the retonation wave. The results of initial flame acceleration show that at first the rate of heat release increases with time associated with the generation of pressure waves. As the flame hits the walls, it loses a lot of its surface area and decelerates. At the same time the pressure waves merge, forming distinct shocks moving forward, rarefactions propagating back toward the flame, and contact discontinuities, which give a good indication of the mass flow velocity. These gas-wave dynamic effects produce flow acceleration ahead of the flame and induce the transition from laminar to turbulent burning, which, in turn, causes another increase in the extent of the combustion zone. The flame accelerates, again sending ahead another pressure fan which reinforces the gas-wave-dynamic effects still further.

308

California U. [Inst. of Engineering Research] Berkeley.

DETERMINATION OF FLAME VELOCITIES IN GASEOUS PREDETONATION, by G. J. Hecht, A. J. Laderman and others. [1960] [5]p. incl. diagrs. refs. [AF 49(638)-166] Unclassified

Published in Rev. Scient. Instr., v. 31: 1107-1111, Oct. 1960.

The application of ionization gap or "pin" probes to measure flame velocities during the development of detonation is presented. Probe construction and circuit

techniques are described which, despite the widely varying character of the ionization signals in this region, yield timing precision of 2% or less for hydrogen-oxygen mixtures. Analysis of the ionization probe circuit permits the identification of the probe signal with the ionization levels encountered in the various waves generated during the development of detonation. In this manner it is possible to differentiate between shocks, flames, and detonation waves and to determine the axial flame velocity profile. (Contractor's abstract)

309

California U. [Inst. of Engineering Research] Berkeley.

ON THE DEVELOPMENT OF DETONATION WITH PRE-IGNITION, by A. K. Oppenheim, R. A. Stern, and P. A. Urtiew. [1960] [7]p. incl. diagrs. (AF 49(638)166) Unclassified

Published in Combustion and Flame, v. 4: 335-341, Dec. 1960.

Importance of pre-ignition to the development of detonation is examined on the basis of a wave dynamic analysis of schlieren photographs obtained by Schmidt, Steinicke, and Neubert. Present results complement those published in the Seventh Symposium (Internat'l) on Combustion (item no. CAL.16:002, Vol. II) for the case without pre-ignition. Although a definite stimulating effect of pre-ignition has been noticed, characteristic features of both solutions being the same, it is concluded that progress of the process, expressed in terms of intermediate states that must be attained in the course of its development, is essentially the same in both cases.

310

California U. Inst. of Engineering Research, Berkeley.

FLOW STUDIES IN AN ARC HEATED LOW DENSITY SUPERSONIC WIND TUNNEL, by C. L. Brundin, L. Talbot, and F. S. Sherman. Apr. 15, 1960 [39]p. incl. illus. diagrs. tables, refs. (Rept. no. HE-150-181; series no. 132, issue no. 2) (AFOSR-TN-60-592) (AF 49(638)502) AD 237468; PB 148009 Unclassified

Several methods for determining the properties of the flow produced in a supersonic low density arc-heated wind tunnel were evaluated using argon as the test gas. These experiments included stagnation point Langmuir probe and heat transfer measurements, impact pressure surveys, and some qualitative spectroscopic studies. A typical set of operating conditions indicated by the measurements were $M \cong 6$, $P_{static} \cong 1$ mm mercury in the free jet, centerline stagnation temperature $T_t \cong 5000°K$, and approximately 0.6% ionization with an electron temperature of about $2 \times 10^4 °K$. (Contractor's abstract)

311

California U. [Inst. of Engineering Research] Berkeley.

LANGMUIR PROBE MEASUREMENTS IN A SUPERSONIC PLASMA JET (Abstract), by L. Talbot. [1960] [1]p. [AF 49(638)502] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 79, Jan. 27, 1960.

Measurements have been made by means of a stagnation point Langmuir probe of the ion concentration and electron temperature in a supersonic low density plasma jet flow. Preliminary results yield an ion concentration of ~0.1% in the uniform core of the flow, with an electron-temperature of 10,000°K. The electron temperature measurements indicate a possible Ramsauer depletion of the high-energy end of the electron distribution, making it non-Maxwellian. Heat transfer measurements at the stagnation point show a variation with potential in accordance with theoretical predictions.

312

California U. Inst. of Engineering Research, Berkeley.

NEW STUDIES OF MOLECULAR SCATTERING AT THE SOLID SURFACE, by F. C. Hurlbut and D. E. Beck. Aug. 11, 1959, 1v. incl. illus. tables, refs. (Rept. no. HE-150-166; series no. 20, issue no. 127) (AFOSR-TN-60-189) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-22245) AD 228255 Unclassified

A molecular beam apparatus is used to study the physics of interaction at the gas surface interface. The spatial distributions of the flux of particles scattered from various surfaces are presented. Data is presented for the scattering of argon atoms and nitrogen molecules from teflon, glass, cleaved crystals of zinc and lithium fluoride, and liquid metal surfaces of gallium and indium.

313

California U. Inst. of Engineering Research, Berkeley.

HEAT TRANSFER, RECOVERY FACTOR, AND PRESSURE DISTRIBUTIONS AROUND A CIRCULAR CYLINDER NORMAL TO A SUPERSONIC RAREFIED- AIR STREAM. PART II. COMPARISON OF EXPERIMENT WITH THEORY, by O. K. Tewfik. May 15, 1959, 1v. incl. illus. diagrs. tables, refs. (Rept. no. HE-150-169; series no. 20, issue no. 128) (AFOSR-TN-60-268) ([Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research] under Nonr-22245) AD 217961 Unclassified

Theoretical methods for the prediction of heat transfer,

recovery factor and pressure distributions around a circular cylinder normal to a supersonic rarefied gas stream are experimentally evaluated by comparison with experimental measurements. The results of extensive measurements of heat transfer, recovery factor and measure distributions obtained in the low pressure wind tunnel of Calif. U. are reported. Interpretation of these results involved essentially the analysis of heat transfer from a laminar compressible boundary layer with pressure gradient and provides an excellent criterion for a critical study and evaluation of pertinent theory. The modified Newtonian theory was compared with the results of pressure distribution measurements in the Mach number range 3.55 - 5.73, and the Reynolds number range 330 - 4100, using an adiabatic and a cooled model. The free stream was rarefied, with its density corresponding to that of the atmosphere at about a 30-40 mi altitude. (Contractor's abstract)

314

California U. Inst. of Engineering Research, Berkeley.

SOME PRELIMINARY RESULTS IN SEPARATED FLOW AERODYNAMICS, by L. L. Lynes and S. A. Schaaf. Feb. 10, 1960 [10]p. incl. illus. diagrs. (Rept. no. HE-150-178; series no. 20, issue no. 133) (AFOSR-TN-60-452) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-22245) AD 234018 Unclassified

It was found that separation existed in the region between the cylindrical body and the forward face of the conical skirt. The separation point was on the shoulder of the hemispherical cap and the reattachment was at or near the heel of the conical skirt. These two points remained nearly fixed as the axial length of the cylinder in front of the conical skirt was increased until a point was reached where the separation point began to slide back along the body. Also, no hysteresis was detected as a function of forward or aft movement of the conical skirt. (Contractor's abstract)

315

California U. Inst. of Engineering Research, Berkeley.

AERODYNAMIC CHARACTERISTICS OF WEDGES IN LOW DENSITY SUPERSONIC FLOW, by S. A. Schaaf, E. S. Moulic and others. Apr. 8, 1960 [65]p. incl. illus. diagrs. tables. (Rept. no. HE-150-180; series no. 125, issue no. 3) (AFOSR-TN-60-703) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-22245; and by General Electric Co.) Unclassified

Experimental measurements of the lift, drag and pitching moment coefficients of wedge-shaped airfoils are presented. The experiments were carried out for and 30° half-angle sharp leading edge wedges at Mach numbers of 4 and 6 and with Reynolds numbers in the range of 1500 to 8900. The results exhibited steady viscous effects, particularly for the slender wedges, and were in reasonably good agreement with a simplified form of "weak interaction" boundary layer theory for a perfect gas. An extension of this theory indicates the probable importance of heat transfer effects on viscous aerodynamic characteristics. (Contractor's abstract)

316

California U. Inst. of Engineering Research, Berkeley.

A STUDY OF OXYGEN RECOMBINATION ON METALLIC SURFACES BY MEANS OF AN ATOMIC BEAM, by S. A. Hoenig. Oct. 7, 1960, 154p. incl. illus. diagrs. tables, refs. (Rept. no. HE-150-173; series no. 20, issue no. 130) (AFOSR-153) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-22245) AD 249612 Unclassified

A series of measurements of the catalytic recombination coefficient γ for recombination of oxygen atoms on various metallic surfaces was made. The technique used in the experiment involved a molecular beam and a new type detector for calibration of the atomic oxygen content of the beam. The previous experiments in the field were discussed, their results compared, and an evaluation of their probable relative validity made. The results are in general qualitative agreement with the present theories of the electronic basis of catalysis and the variation in the data is somewhat less than that reported by other observers. (Contractor's abstract)

317

California U. [Inst. of Engineering Research] Berkeley.

FREE-MOLECULE FLOW OVER NONCONVEX SURFACES, by M. T. Chahine. Oct. 14, 1960 [45]p. incl. diagrs. refs. (Rept. no. HE-150-177; series no. 20, issue no. 131) ([Sponsored jointly by Air Force Office of Scientific Research] and Office of Naval Research under Nonr-22245) AD 245434 Unclassified

Also published in Rarefied Gas Dynamics; Proc. Second Internat'l. Symposium, California U., Berkeley [Aug. 3-6, 1960] New York, Academic Press, 1961, p. 209-230.

The problem of free molecule flow over non-convex surfaces is investigated, and the fundamental integral equations for an infinitely long cylindrical surface with a longitudinal slit and a concave spherical segment are obtained. For purely diffuse reemission the total number flux of particles at any point on the surface is given by a Fredholm type integral equation of the second kind. An energy flux integral equation is obtained which deals with the two cases of perfect and partial surface accommodation. The momentum exchange is formulated, assuming that all recoil particles from an element of surface are reemitted at one effective recoil temperature. For complete surface accommodation this temperature is equal to that of the wall, and finally, normal

and axial forces are computed. The integral equations for the two surfaces are solved under the assumption that the incident stream possesses no random thermal motion. Exact, closed form, analytical solutions are obtained for the distribution of the total number flux, the convective heat transfer with perfect and partial surface accommodation. These results are compared with the theory of free molecule flow over convex surfaces. The effect of inter-reflections is to increase the over-all values of convective heat transfer to the surface while it tends to increase or decrease the net axial forces depending on the concavity of the surface. (Contractor's abstract)

318

California U. [Inst. of Engineering Research] Berkeley.

SOME STUDIES IN SEPARATED FLOW AERODYNAMICS (Abstract), by S. A. Schaaf and L. L. Lynes. [1960] [1]p. [Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-22245] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 43, Jan. 27, 1960.

Aerodynamic flows in which separation occurs on a considerable portion of the forward part of the configuration offer a number of promising features. However, very little is known as to the structure of such flows. Accordingly, some experiments were carried out in the Berkeley low-density supersonic wind tunnel to determine pressure distributions for such configurations.

The tests were run at M = 6 and at Re = 10^4 based on free stream conditions and the model diameter. The geometry investigated was a sphere-nosed cylinder with a 45° conical skirt located a variable distance downstream from the leading edge. Models were tested at 0 and 20° angle of attack. Results were in general agreement with a relatively simple theoretical model for the flow.

319

California U. [Inst. of Engineering Research] Berkeley.

HEAT TRANSFER, RECOVERY FACTOR, AND PRESSURE DISTRIBUTIONS AROUND A CIRCULAR CYLINDER NORMAL TO A SUPERSONIC RAREFIED-AIR STREAM, by O. K. Tewfik and W. H. Giedt. [1960] [9]p. incl. diagrs. refs. ([Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research] under Nonr-[illegible]245) Unclassified

Presented at Twenty-eighth annual meeting of the Inst. Aeronaut. Sci., Hypersonic Phenomena Session, New York, Jan. 25-27, 1960.

Published in Jour. Aero/Space Sci., v. 27: 721-729, Oct. 1960.

Measurements of the heat transfer, recovery factor, and pressure distributions around a circular cylinder normal to a supersonic rarefied-air stream (total temperature ≅ 300°K.) are described for the Mach number range of 1.3 to 5.7, the Reynolds number range of 37 to 4,100 and at cylinder wall average temperature levels of 90 and 210°K. Study of the results yielded: (1) a correlation equation for the stagnation-point Nusselt number as a function of the Reynolds number just after the normal part of the detached bow shock wave; and (2) Fourier series expressions for the heat-transfer coefficient and pressure coefficient distributions in terms of the stagnation-point values. In comparing these measurements with predictions based on recent analytical studies, exceptionally good agreement for the heat-transfer coefficient distribution was obtained with Lees' theory. In the Mach number range of 3.55 to 5.73 the pressure decreased less rapidly with distance from the stagnation point than predicted by the modified Newtonian theory. (Contractor's abstract)

320

California U. [Inst. of Engineering Research] Berkeley.

MOLECULAR SCATTERING AT THE SOLID SURFACE, by F. C. Hurlbut. [1959] [12]p. incl. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under [N7onr-29503]) Unclassified

Published in Recent Research in Molecular Beams, New York, Academic Press, 1959, p. 145-156.

A series of studies are described which discuss the consequences of the findings to fluid friction in a rarefied gas flow. The work utilizes a conventional atomic beam apparatus. The salient feature of the findings was that by far the greatest number of molecules are scattered at random. The measured flux distributions adhere to the cosine or "diffuse" scattering pattern and show no sharp perturbation of that pattern. There is in evidence, however, a small but measurable departure from cosine scattering in the cases of the glass and Teflon surfaces. In the case of the glass surface, it appears that the fraction so scattered increases with increasing angle of incidence to a certain limit. The distortion of cosine scattering in the case of Teflon persists to substantially smaller angles of incidence than in the case of glass.

321

California U. Materials Research Lab., Berkeley.

ORIGIN AND PROPAGATION OF CRACKS IN MAGNESIUM OXIDE SINGLE CRYSTALS, by K. Muray, E. R. Parker, and L. Himmel. May 1960, 29p. incl. illus. diagrs. refs. (Technical rept. no. 1; series no. 150, issue no. 1) (AFOSR-TN-60-554) (AF 49(638)601) AD 241095; PB 150005 Unclassified

Small impurities in the form of precipitates play 3 very important roles in the mechanical behavior of MgO single crystals. The main sources of dislocations are probably precipitates in these crystals; moving dislocations interact with precipitates and in doing so multiplication occurs. The distribution of precipitates determines the "dangerous" points where cracks begin to nucleate. The most "dangerous" configuration is one in which a precipitate is located at some critical distance L from the intersection point of slip bands. The cleavage steps on a fractured or cleaved surface occur at locations where precipitate particles are concentrated.

322

California U. Materials Research Lab., Berkeley.

INVESTIGATION OF FACTORS CONTROLLING PROPERTIES OF PRESSURE-SINTERED ALKALI HALIDES, by P. J. Fetta and E. R. Parker. June 1960, 23p. incl. illus. diagrs. tables. (Technical rept. no. 2; series no. 150, issue no. 2) (AFOSR-TN-60-707) (AF 49(638)601) AD 243979 Unclassified

A method is described for producing fine-grained polycrystalline alkali halides by a vacuum pressure sintering technique. It is shown that transparent disks may be prepared from any of the alkali, silver, or ammonium halides. To accomplish this, sufficient pressure, a sufficiently low vacuum, and fine-grained powder of high purity and a reasonably low moisture content must be used. If powder which has not been freshly prepared is used, surface contamination imparts a yellow coloration to the final disk. As the powder ages, this coloration increases until finally only translucent or opaque disks are obtained. The pressure at which a material becomes transparent is related to its lattice energy. The softest disk is produced not at the lowest pressure for transparency but at a higher pressure. This effect seems to be due to surface contamination. The plates are of almost theoretical density.

323

California U. Materials Research Lab., Berkeley.

VACANCY CLUSTERS IN ALKALI HALIDE CRYSTALS, by C. A. Johnson and E. R. Parker. Aug. 1960, 75p. incl. diagrs. tables. refs. (Technical rept. no. 3; series no. 150, issue no. 3) (AFOSR-TN-60-979) (AF 49(638)-601) AD 243935 Unclassified

The possibility of the formation of small dislocation loops in alkali halide crystals by the precipitation of an excess of vacancies is discussed on the basis of a Born-Mayer theory of cohesion in ionic crystals. There are strong attractive interactions among vacancies and vacancy clusters in the alkali halides. Arguments are presented which suggest that vacancy precipitates in the alkali halides will be predominantly in the form of monolayer plates. This contradicts arguments which predict the formation of spheroidal precipitates (voids) on the basis of surface energy considerations. The conclusion that monolayer vacancy precipitates will predominate is reached by considering the sequence of reactions leading to the formation of planar and spheroidal vacancy clusters and imposing the requirements that a cluster grow in such a way as to keep its energy at a minimum. The formation of spheroidal vacancy precipitates was found to be inhibited by the appearance of high energy clusters. Detailed calculations were made for the formation energies of small vacancy clusters containing up to 8 vacancies. Clusters of this type represent an important stage in the nucleation and growth of either planar or spheroidal precipitates. The law of mass action has been applied to the reactions occurring among the clusters for which formation energies have been computed. Concentrations of these clusters as a function of total vacancy concentration and temperature have also been computed. (Contractor's abstract, modified)

324

California U. [Minerals Research Lab., Berkeley].

MODEL POLYPHASE CERAMIC SYSTEMS AND RESULTANT STRESS SYSTEMS, by R. M. Fulrath. [1960] [25]p. incl. illus. diagrs. tables, refs. (AFOSR-TN-60-803) (AF 49(638)4) Unclassified

Also published in Mechanical Properties of Engineering Ceramics; Proc. of a Conf., Raleigh, N. C. (Mar. 9-11, 1960), New York, Interscience Publishers, Inc., 1961, p. 549-573.

The existence of internal stresses in ceramics may be determined by x-ray diffraction analysis. If the x-ray wavelength used does not penetrate more than one particle diameter, biaxial analysis of surface crystals may be made. If the x-ray beam penetrates more than one particle diameter, only crystals in simple biaxial stress states will give x-ray diffraction line shift. Complex microstructures where the individual crystals are under complex stresses lead to x-ray line broadening and are difficult to analyze.

325

California U. [Minerals Research Lab.] Berkeley.

DUCTILITY OF MAGNESIUM OXIDE, by E. R. Parker. [1960] [23]p. incl. illus. diagrs. refs. [AF 49(638)4] Unclassified

Published in Mechanical Properties of Engineering Ceramics; Proc. of a Conf., Raleigh, N. C. (Mar. 9-11, 1960), New York, Interscience Publishers, Inc., 1961, p. 65-87.

The factors affecting ductility of simple ionic crystals are discussed. Topics included are surface defects, the factors affecting plastic properties, and the origin

of cracks. The problems associated with the fostering of ductile behavior in polycrystalline materials are summarized. (Contractor's abstract)

326

California U. Minerals Research Lab., Berkeley.

DUCTILE CERAMICS, by E. R. Parker, J. A. Pask, and L. Himmel. Final rept. Feb. 1960, 6p. (Series no. 109, issue no. 3) (AFOSR-TR-60-26) (AF 49(638)56) AD 234699; PB 146841 Unclassified

A study was made of the mechanical behavior of ceramic materials in order to establish the basic reasons for the brittleness of such materials and to determine, if such such materials are not inherently brittle, whether a degree of plasticity could be imparted to make them useful for structural applications. NaCl, KCl, KBr, NaI, KI, LiF, and CsBr appeared to be inherently ductile rather than brittle when tested in simple 3-point bending. The ductility was generally quite sensitive to the condition of the specimen surface, and in some cases it (NaCl) was impaired by exposure to the atmosphere. O and N were responsible for decreased ductility of certain water-soluble salts. Impurities raise the yield stress and decrease the total strain of fracture. Heat treatment to about 2200°C for 1/2 hr followed by rapid cooling decreased the yield stress and increased the total ductility in MgO.

327

California U. Minerals Research Lab., Berkeley.

[GROWTH OF SLIDE BANDS AND NUCLEATION OF CRACKS IN MAGNESIUM OXIDE] Croissance de bandes de glissement et apparition d'amorces de fissures dans l'oxyde de magnesium, by J. Washburn and A. E. Gorum. [1960] [5]p. incl. illus. diagrs. [Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)56 and Office of Naval Research] Unclassified

Presented at Fall Metallurgical Session of French Soc. Metall., Paris, Oct. 23, 1958.

Published in Rev. de Metall., v. 57: 67-72, Jan. 1960.

Low-temperature plastic deformation of MgO crystals takes place entirely by growth of $\{110\}\langle 1\bar{1}0\rangle$ slip bands. Shear strain within a band remains constant at about 10% as it widens. Dislocation motion takes place only at the interface between deformed and undeformed parts of the crystal. The pile-up at the intersection depends on the stress concentration produced at the intersection of wide slip bands.

328

California U. Minerals Research Lab., Berkeley.

A DIPHENYL ETHER CALORIMETER FOR MEASURING HIGH TEMPERATURE HEAT CONTENTS OF METALS AND ALLOYS, by R. Hultgren, P. Newcomb and others. [1960] [6]p. incl. illus. refs. [Technical note no. 3; series no. 137, issue no. 3] (AFOSR-TN-60-208) (AF 49(638)83) AD 238077 Unclassified

Also published in The Physical Chemistry of Metallic Solutions and Intermetallic Compounds; Proc. of Symposium no. 9, Nat'l. Physical Lab., London (Gt. Brit.) (June 4-6, 1958), New York, Chemical Publishing Co, Inc., 1960, v. 1: 118-124.

A diphenyl ether calorimeter has been designed and applied to the determination of heat contents of metals. It proves to be much less expensive and simpler to operate than the more usual type and has comparable accuracy (± 10 cal/g-atom %). The instrument has been calibrated and the absolute heat loss at any temperature was the quantity of heat which, added to the experimental value for each specimen, give equal heat contents per gram. (Contractor's abstract, modified)

329

California U. [Minerals] Research Lab., Berkeley.

SPECIFIC HEAT OF METALS AND ALLOYS, by R. Hultgren. June 1, 1960, 28p. incl. diagrs. tables. (Technical note no. 4; series no. 137, issue no. 4) (AFOSR-TN-60-527) (AF 49(638)83) AD 239241; PB 148515 Unclassified

Presented at Third annual Conf. for Sponsors, Purdue U. School of Mechanical Engineering, Thermophysical Properties Research Center, Ind., Mar. 29, 1960.

In measuring the C_p of such low melting metals as K, Pb, Li, Na, and Hg there is a pronounced fall with T of C_p (the heat capacity for liquids and solids). In 3 of the cases this is followed by a rise beginning at something more than twice the melting point. Hultgren has measured 3 more liquids, Sn, In, and Bi, observing in each case a fall of C_p with melting point. It was not possible to determine if a later rise occurs. It does seem, however, to be a general law that the heat capacity of liquid metals decreases with temperature. Many alloys obey Kopp's law under certain conditions. For harmonic lattice vibrations at high temperatures, C_v for elements and alloys alike should be $C_v = 3R$. For the $C_p - C_v$ contribution Kopp's law will be obeyed if the thermal coefficient of expansion and compressibility are intermediate, or vary in the correct proportion, or $C_p - C_v$ is too small to make much difference.

330

California U. Minerals Research Lab., Berkeley.

HIGH TEMPERATURE HEAT CONTENTS OF SOME BINARY IRON ALLOYS, by W. B. Kendall and R. Hultgren. [1960] [8]p. incl. tables. (Technical note no. 5; series no. 137, issue no. 5) (AFOSR-274) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)83 and American Iron and Steel Institute) AD 255444 Unclassified

Presented at Forty-second annual Convention of the Amer. Soc. for Metals, Philadelphia, Pa., Oct. 17-21, 1960.

The heat contents of some binary alloys of iron with cobalt, chromium, manganese, and silicon have been measured over the range 298.15 to 1400°K using a diphenyl-ether drop-type calorimeter with an average experimental precision of about ± 0.3%. Deviations from Kopp's law have been tabulated. An anomaly, possibly an antiferromagnetic Néel temperature, was discovered at 517°K in $Fe_{0.512}$ $Mn_{0.488}$ and at 380°K in $Fe_{0.696}$ $Mn_{0.304}$. (Contractor's abstract)

331

California U. School of Public Health, Berkeley.

EXPERIMENTS WITH AIR IONS ON THE TRACHEA, by J. C. Beckett and A. P. Krueger. 1960 [5]p. incl. illus. diagrs. refs. (AFOSR-TN-60-621) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)669, Atomic Energy Commission, and National Institutes of Health) AD 255417 Unclassified

Presented at Winter General meeting of the Amer. Inst. Elec. Engineers, New York, Jan. 31-Feb. 5, 1960.

Also published in Trans. Amer. Inst. Elec. Engineers, v. 79 (Part I): 695-699, Jan. 1961.

Negative air ions have been shown to be beneficial to respiration, but this does not mean that negative ions alone will cure a respiratory ailment or relieve a diseased condition. There is no evidence to suggest that positive ions cause asthma or hay fever; the most that can be concluded is that positive ions enhance susceptibility to trauma, may account for some mucosal irritation and may set the stage for infection if other conditions are also present. Electrical engineers will appreciate their responsibility in the application of electrical equipment in confined spaces to avoid positive ion space charges in view of these findings. Extremes of the engineer's problem can be found on modern nuclear submarines and space ships. Closed atmospheric systems need careful study of air ions as a part of providing the most favorable environment. At the scientific level, the biophysicists and physiologists have a new challenge in the study of electrical effects on cells and tissue. Previously it was not suspected that such small quantities of electricity could cause any measurable response. Improved measuring devices and techniques have helped to make this possible.

332

California U. School of Public Health, Berkeley.

THE BIOLOGICAL MECHANISMS OF AIR ION ACTION. II. NEGATIVE AIR ION EFFECTS ON THE CONCENTRATION AND METABOLISM OF 5-HYDROXYTRYPTAMINE IN THE MAMMALIAN RESPIRATORY TRACT, by A. P. Krueger and R. F. Smith. 1960 [8]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1055) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)669 and National Institutes of Health) AD 249335 Unclassified

Also published in Jour. Gen. Physiol., v. 44: 269-276, Nov. 1960.

Negative air ions are shown to decrease 5-hydroxytryptamine concentrations in extirpated strips of rabbit trachea and in the respiratory tracts of living mice. An initial exposure of guinea pigs to (-) air ions causes a transient rise in urinary 5-hydroxyindoleacetic acid excretion which is not observed upon subsequent exposures. These findings are compatible with the hypothesis advanced earlier that (-) air ion effects depend on the ability of (-) ions to accelerate enzymatic oxidation of 5-hydroxytryptamine. (Contractor's abstract)

333

California U. School of Public Health, Berkeley.

STUDIES ON THE EFFECTS OF GASEOUS IONS ON THE MAMMALIAN TRACHEA, by A. P. Krueger and R. F. Smith. [1960] [9]p. incl. diagrs. (AFOSR-TN-60-1339) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)669 and National Institutes of Health) Unclassified

Also published in Biometeorology, Proc. of the Second Internat'l. Bioclimatological Congr., London (Gt. Brit.) (Sept. 4-9, 1960), New York, MacMillan Co., 1962, p. 498-506.

Experimental methods were developed to study the effects of gaseous ions on the tracheal mucosa in situ and in excised strips. Positively charged CO_2 decreased the ciliary rate, contracted the posterior tracheal wall, induced a state of exaggerated susceptibility to mild mechanical trauma, caused vasoconstriction in the tracheal wall and increased the respiratory rate. Negatively charged oxygen: increased the ciliary rate, reversed the positive ion-induced contraction of the tracheal, did not alter the mucosal response to mild trauma, did not change the normal vascularity and decreased the respiratory rate. All 5 effects are demonstrable in the living tracheotomized animal; only the first 3

are demonstrated in the excised strip. All the tracheal effects attributed to positively charged CO_2 are also produced by the intraveneous injection of 5-hydroxytryptamine (5-HT). The following hypotheses have been tested: (1) Positive air ion effects on the trachea are due to the release and local accumulation of 5-HT and (2) negative ions reverse positive ion effects by accelerating the rate at which 5-HT is oxidized. The experimental results are compatible with the hypotheses. (Contractor's abstract)

334

California U. [Brain Research Inst.] Los Angeles.

INSTRUMENTATION OF NERVOUS SYSTEM FOR STUDIES OF BEHAVIOR AND PERFORMANCE IN SPACE FLIGHT, by W. R. Adey. [1960] [14]p. incl. diagrs. (AFOSR-2288) (AF 49(638)686) Unclassified

Also published in I.R.E. Trans. Fifth Nat'l. Symposium on Space Electronics and Telemetry, Washington, D. C. (Sept. 19-21, 1960), New York, Inst. of Radio Engineer., 1960, p. 6-2.

The methods used to glean some of the knowledge existing today concerning brain activities are briefly discussed. It is pointed out that the brain stem has been established as one of the chief sites of integrative action of the brain. The cybernetic notion of a series of reverberant circuits between the cerebral cortex and subcortical structures as a concept has been disproved by more intimate experimentation of the nervous system. Electrode implantation has been a useful tool of the neuro-physiologists. More recently, stereostatic location of these electrodes has helped clarify many structure-function correlations. The use of amplifiers and recording systems has aided in the search for data as has the use of computers. Similarly simulation studies have also been very useful in understanding the brain's activity. It is concluded that the research of tomorrow will probably involve the engineer and his mathematical approach. It is hoped that first, however, the engineer will learn biology before attempting to extrapolate from models to the spinal cord.

335

California U. Dept. of Astronomy, Los Angeles.

POSITIONS, VELOCITIES, EPHEMERIDES REFERRED TO THE DYNAMICAL CENTER, by S. Herrick. July 1960, iv. incl. tables, refs. (Astrodynamical rept. no. 7) (AFOSR-TN-60-773) (In cooperation with Aeronutronic, Newport Beach, Calif.) (AF 49(638)498) AD 250757 Unclassified

New developments in the field of astrodynamics are given with specific reference to problems of obtaining position and velocity for a given time from a set of orbital elements. Singularities in the problem occur when the eccentricity is zero or unity. A solution to Kepler's Equation on the Comrie pattern is an excellent solution of the problem from the point of view of using a desk calculator. A careful review is presented of the formulation of the equations for the nearly circular ellipse, and introduces the use of the unit vectors U and V. Kepler's Equation is presented in such a form that it is not necessary to solve for the eccentricity or to divide by the eccentricity at any point. A series is introduced for nearly rectilinear or nearly parabolic orbits which may be used as well in differential correction schemes and perturbations by variation of parameters. A set of universal formulae is presented which are applicable to all of the conic sections, including the singular cases. A compilation of basic knowledge in the field of astrodynamics is included. (Contractor's abstract)

336

California U. Dept. of Astronomy, Los Angeles.

VARIATION OF PARAMETERS, by S. Herrick. July 1960, iv. incl. diagrs. tables, refs. (Astrodynamical rept. no. 9) (AFOSR-TN-60-812) (In cooperation with Aeronutronic, Newport Beach, Calif.) (AF 49(638)498) AD 250759

The method of variation of parameters for perturbation integration differs from the traditional methods of Cowell and Encke in that it derives greater accuracy from a smaller number of integration steps. It was found by computers that the labor of computing the variation of the parameters from the perturbations is small in contrast to that of computing the perturbations themselves from the coordinates of the 7 disturbing planets. (Contractor's abstract)

337

California U. Dept. of Astronomy, Los Angeles.

ORBITS FROM POSITION AND VELOCITY, by S. Herrick. July 1960 [59]p. incl. diagrs. tables. (Astrodynamical rept. no. 8) (AFOSR-TN-60-816) (In cooperation with Aeronutronic, Newport Beach, Calif.) (AF 49-(638)498) AD 250758 Unclassified

A general orbit determination scheme is given for non-singular cases, where $\underline{r}_0$ (x_0,y_0,z_0) and $\dot{\underline{r}}$ $(\dot{x}_0,\dot{y}_0,\dot{z}_0)$ with the corresponding epoch, t_0, are known. Special cases of the conic are considered using new quantities developed to avoid discontinuities. The vector quantities $\underline{U}_0$ and $\underline{V}_0$ are used for the nearly circular case, and other newly developed quantities are used for the parabolic and rectilinear cases. The determination of other quantities of interest as well as the orbital elements is also discussed. Distance and time of flight, apogee distance, takeoff and landing velocities, effective radius of a body, determination of a hit or miss, and descent

from a satellite orbit are all considered, and many direct applications to satellite and interplanetary orbit problems are presented.

338

California U. Dept. of Astronomy, Los Angeles.

ASTRODYNAMICAL NOTATION AND USAGE, by S. Herrick, M. W. Makemson, and M. P. Francis. July 15, 1960, 18p. (Astrodynamical rept. no. 10) (AFOSR-TN-60-856) (In cooperation with Aeronutronic, Newport Beach, Calif.) (AF 49(638)498) AD 250760 Unclassified

A list is presented of astrodynamical abbreviations and symbols. The need for such a listing is pointed out, and it is hoped that these terms will be used when appropriate and not be considered a must for all respectable writing in the field. The list includes over 300 terms.

339

California U. Dept. of Astronomy, Los Angeles.

RECENT ADVANCES IN ASTRODYNAMICS, 1960, by R. M. L. Baker, Jr. [1960] [14]p. incl. tables, refs. (Astrodynamical rept. no. 11) (AFOSR-TN-60-1231) (AF 49(638)498) AD 263781 Unclassified

Also published in ARS Jour., v. 30: 1127-1140, Dec. 1960.

The advances made in astrodynamics are discussed. A comprehensive listing of about 80% of the papers published in 1960, prior to September, plus a few of older vintage are presented. The advances made are reviewed in all fields including geometry and coordinate systems, astrodynamic constants, orbit determination, n-body problem, special and general perturbations, non-gravitational and relativistic effects, observation theories, attitude dynamics, and orbit selection and transfer. In addition those papers exhibiting application to space vehicle systems are discussed, the greatest emphasis being in the field of orbital rendezvous or intercept.

340

California U. [Dept. of Astronomy] Los Angeles.

ASTROMECHANICS, by S. Herrick. Sept. 16, 1959 [58]p. incl. diagrs. tables. (AFOSR-3981) (AF 49(638)-498) Unclassified

Presented at Symposium on Frontiers of Science and Engineering, California U., Los Angeles, Sept. 16, 1959.

Certain aspects of astrodynamics are discussed in relation to past practices and expected future practices. Explanation is given on the various techniques of navigation, such as observation made from a vehicle and observation made of a vehicle. The application of Kepler's three laws of motion and Newton's modification of them is pointed out. It is explained that Newton's modification of these laws allows them to be applied to motions of satellites around planets as well as to the motion of planets around the sun, which was all that Kepler had to study when he formulated his principles. The author also explains Newton's vis-viva integral which adds velocity to the problems of orbital shape and period. Some theoretical approaches to sending a space ship to Venus and to the moon are considered. The perturbations that would have to be considered for such a trip are discussed in some detail. Other problems of interplanetary travel are also touched on such as the possibility of sending a man to the moon when we are reasonably sure that we can supply him there instead of waiting until we can be certain of bringing him back. The problems of intercepting and rescuing a man marooned in space with limited supplies is also considered. Finally it is pointed out that this field of study is dependent upon precision and accuracy.

341

California U. [Dept. of Astronomy] Los Angeles.

DIFFERENTIAL REPRESENTATIONS, CORRECTIONS, AND ERROR ANALYSIS, by S. Herrick. [1959] [101]p. incl. diagrs. tables, refs. (AFOSR-3982) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)498 and National Aeronautics and Space Adminstration under NAS 1-204) Unclassified

There are differential formulae that are useful more than once. The desire to segregate them all into one chapter is great but impractical. It is the aim of this report, however, to bring together some of the problems of differential processes to illustrate basic needs and solutions, and to develop formulae that can be cited elsewhere. With the advent of the rocket, differential correction has developed two facets: the correction of a hypothesis to fit physical conditions, and the correction of physical conditions to fit a hope. Residuals, which are differences between observation and calculation, or sometimes between preliminary and revised values of non-observational quantities, serve two purposes: (1) testing or evaluation of the constants used in the calculation, and (2) improvement or correction of these constants. Differential representation is essentially a shortcut process, a way to determine expeditiously residuals that will serve to calculate a given approximation to an orbit. It is a process for determining observed-minus-computed residuals differentially from preliminary-minus-computed ones, avoiding the recalculation of many quantities that have already been determined preliminarily, and making it possible to replace precise calculation by estimate. Astronomical and rocket problems will both be concerned, in error analysis, with the range of possible orbits that fit somewhat uncertain initial conditions or moderately broad final conditions. In the former, it is necessary to

estimate the uncertainty in the ephemeris of a minor planet that was not sufficiently observed for its orbit to be well determined, and in the latter there is a need to know what ranges there may be in the orbital elements.

342

California U. [Dept. of Astronomy] Los Angeles.

THE CONIC SECTIONS, by S. Herrick. [1960] [36]p. incl. diagrs. (AFOSR-3983) (AF 49(638)498) Unclassified

Kepler's laws, especially the first one as revised by Newton, direct attention to the conic section. These are reviewed from the geometrical point of view. A conic is defined as the locus of the points in a plane whose distances, from a fixed point (the focus) bear a constant ratio (the eccentricity) to their perpendicular distances from a straight line (the directrix). With this as a basis, the integration of the two-body problem is studied. The aim of this discussion is to develop, in as short a space as possible, basic formulae whose value is not limited to one use.

343

California U. Dept. of Astronomy, Los Angeles.

AN INTRODUCTION TO ASTRODYNAMICS, ed. by R. M. L. Baker, Jr. and M. W. Makemson. New York, Academic Press, 1960, 358p. incl. diagrs. tables, refs. (In cooperation with Aeronutronic, Newport Beach, Calif.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)498, Army Ballistic Missile Agency under DA 04-495-ORD-1389, and National Astronautics and Space Administration under NAS-5-76 and NAS-1-204) Unclassified

The text of this publication is the outgrowth of course notes for an intensive summer course in astrodynamics presented annually by Dr. Baker. The course itself was derived from a similar semester-long course given by Dr. Herrick. This volume is meant to provide a true introductory textbook in the field of astrodynamics that could be utilized on a college level. The book is organized on the basis of two broad divisions: Fundamentals and More Detailed Analysis. The chapters included under fundamentals contain discussions of general laws, minor planets, comets, geometry, and the astrodynamic constants. A mastery of this division would allow for an approximate solution of most astrodynamic problems. Included in the more detailed analyses are chapters concerned with orbit-determination, n-body problem, orbit computation, non-gravitational forces, observation theory, and applications to interplanetary orbits. Mastery of this division would provide for more definitive and sophisticated orbit analyses.

344

California U. Dept. of Chemistry, Los Angeles.

COMPARISON OF VARIOUS LEAST SQUARES REFINEMENT TECHNIQUES, by R. A. Sparks. Apr. 1960, 33p. incl. diagr. tables, refs. (Research rept. no. UOC-2) (AFOSR-TN-60-468) (AF 49(638)719) AD 237762 Unclassified

Also published in Computing Methods and the Phase Problem in X-ray Crystal Analysis; Report of a Conf., Glasgow (Scotland) (Aug. 10-12, 1960), New York, Pergamon Press, 1961, p. 170-187.

The convergence properties of the least squares method as used in several computing laboratories are investigated. Methods are found to lead to convergence for the refinement of anthracene; various acceleration devices greatly speed this convergence. By storing the observational equations, it is possible to get nearly the same parameter shifts as would be obtained from the full matrix method but without actually forming this full matrix. For problems with a large number of parameters, this method can lead to a great saving of computer time. A recommended least squares program is described. This program involves storage of the observational equations, calculation of the same blocks of the normal equations matrix, and utilization of the conjugate-gradient acceleration device. (Contractor's abstract)

345

California U. Dept. of Chemistry, Los Angeles.

CRYSTALLOGRAPHIC CALCULATIONS ON SWAC AND ON THE IBM 709, by R. A. Sparks, M. M. Blattner and others. Apr. 1960 [11]p. (Research rept. no. UOC-1) (AFOSR-TN-60-469) (AF 49(638)719) AD 237763 Unclassified

Also published in Computing Methods and the Phase Problem in X-ray Crystal Analysis; Report of a Conf., Glasgow (Scotland) (Aug. 10-12, 1960), New York, Pergamon Press, 1961, p. 188-193.

Changes made in the SWAC during the last 4 yr and the operational efficiency of the IBM 709 are described. A magnetic core storage of 512-word capacity has replaced the Williams-tube high speed memory in the SWAC. This allows a gain of more than 2 in basic add time. The chief addition has been a full-matrix least squares routine which can handle a matrix of size 64 x 64. The IBM 709 is a data-processing system designed to be considerably more efficient, especially with respect to input and output operations, than older computers of comparable speed. It consists of at least 2 computers, coordinated through a central processing unit and operating in parallel. One computer, the "main frame", handles all calculations not having to do with input or output operations and is connected to the central processing unit. The other computer or computers handle the input and output operations.

346

California U. [Dept. of Chemistry] Los Angeles.

CHEMICAL KINETICS AT HIGH TEMPERATURE PRODUCED BY SHOCK WAVES (Abstract), by E. R. Hardwick. [1960] [1]p. (AF 49(638)733)
Unclassified

Presented at First AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, General Dynamics Corp. General Atomic Div., San Diego, Calif., Sept. 6-7, 1960. (AFOSR-TN-60-1063; AD 246174)

A shock tube is introduced in which unimolecular decompositions in a fairly wide temperature range (from about 650 to 1500°) is studied, with the hope of making a determination of the temperature dependence of the pre-exponential Arrhenius factor. Study of the mechanism of the initial steps of fuel-oxidizer reaction in the gas phase at high temperatures by employing the isotope effect, using deuterated fuels is also planned. The shock tube is essentially complete, and, as of Aug. 1960, was beginning to show preliminary results.

347

California U. Dept. of Chemistry, Los Angeles.

SIZE EFFECTS AMONG ISOTOPIC MOLECULES, by H. W. Joy and W. F. Libby. [1960] [1]p. (AFOSR-TN-60-654) (Also bound with its AFOSR-TN-60-1269; AD 247702) [AF 49(638)901] Unclassified

Also published in Jour. Chem. Phys., v. 33: 1276, Oct. 1960.

The possibility of a pressure effect due to the volume differences in the zero point state for isotopic reactions is considered. A reaction such as H_2O^{18} + $CaCO_3$ calcite = H_2O + $CaCO_3^{18}$ calcite may have a net change in volume. It is assumed that the average volume per molecule for a single O^{18} substitution is 1/3 of that for the fully substituted ion and at a depth in the ocean of about 3000 feet k is increased by 0.0019 which corresponds to ~1°C on the Urey temperature scale. This effect should be directly measurable in the laboratory at high pressures, and effects of similar magnitude should apply to the phosphate and silicate oxygen isotopic equilibria with water.

348

California U. Dept. of Chemistry, Los Angeles.

OPTICAL TRANSPARENCY AND RESISTANCE TO FLASH HEATING, by W. F. Libby. [1960] [2]p. (AFOSR-TN-60-662) (Also bound with its AFOSR-TN-1269; AD 247702) (AF 49(638)901) AD 313304
Unclassified

Also published in Jour. Chem. Phys., v. 33: 1588-1589, Nov. 1960.

Several principles are pointed out that can be made in the ballistic nose cone problem and in the use of plastic paints to resist flash heating. Optical transparency when combined with low thermal conductivity allows very high temperature gradients to be maintained allowing the surfaces of such solids to be very hot while the bulk solid a short distance away is unperturbed. In this way high temperature evaporation becomes possible and heats of vaporization rivaling those of the highest boiling solids can be achieved. One would expect that the vapor generated at the surface of such a solid would have a composition corresponding to its temperature. Thus close to the surface of an organic plastic, a monomer would probably predominate, while farther out the monomer would be broken into radicals and atoms, some of which might be carried away in the air and serve as a heat sink.

349

California U. Dept. of Chemistry, Los Angeles.

CHEMICAL EFFECTS OF RADIATION, by W. F. Libby. Sept. 30, 1960 [63]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1269) (AF 49(638)901) AD 247702
Unclassified

Research on the chemical effects of radiation completed is presented for review. The theory of the chemistry of ions is discussed as well as the chemistry of neutron moderation. Size effects among isotopic molecules, the nose cone problem, and the uranium oxides are also considered. Discussion is also given on the tritium geophysics and the future plans for the next biennium. This six months report also includes some related sub-reports.

350

California U. Dept. of Chemistry, Los Angeles.

CHEMISTRY OF POSITIVE IONS. I. GENERAL THEORY. II. RADIATION INDUCED CROSS LINKAGE OF POLYMERS, by W. F. Libby. [1960] [31]p. incl. diagrs. tables, refs. (AFOSR-563) (Also bound with its AFOSR-TN-60-1269; AD 247702) (AF 49(638)901)
Unclassified

Also published in Jour. Chem. Phys., v. 35: 1714-1722, Nov. 1961. (Title varies)

The chemical properties of ionized matter are assuming more importance. The latest high vacuum pump - the Ion Pump - operates on the principle that ions are chemically active and can thus be removed from vacuum systems so the combination of an electric discharge and finely dispersed titanium metal serves to give the highest vacua known on earth at the present time. The Sherwood-Project of the AEC - the effort to tame the

thermonuclear reaction - handles plasma in bulk and will eventually encounter serious materials problems. The ion propulsion engine necessary for space travel and now under intensive development assumes a knowledge of all of the important properties of plasma and ion beams. The recent discovery of trapped noble gases in meteorites - gases which can be evolved by heating to 300° or 400°C strongly suggests that an accretion of these gases may be occurring as the meteorites travel through space by a mechanism similar to that of the Ion Pump. The ionized gases react with the meteorite surface and are imbedded either by their initial velocity or by the recoil incident on the neutralization of the ion molecule they form with the surface material. (Contractor's abstract)

351

California U. Dept. of Chemistry, Los Angeles.

STRATOSPHERIC MIXING FROM RADIOACTIVE FALLOUT, by W. F. Libby and C. E. Palmer. [1960] [11]p. incl. diagrs. tables, refs. (AFOSR-3287) [AF 49(638)901] Unclassified

Also published in Jour. Geophys. Research, v. 65: 3307-3317, Oct. 1960.

The radioactive fallout during 1959 shows that the Russian October 1958 debris dominated the northern hemisphere and came down with a residence time corresponding to about 8 months. The rest of the world experienced a steady fallout rate of about .06 mC/mi^2/in. of rain throughout the year, whereas this value was approached during September, October, and November for the northern hemisphere when the Russian debris had apparently been exhausted. The above value is probably due to the equatorial tests. It has been suggested by Goldie that the meridional circulation at levels well within the stratosphere consists of an up-welling of air at the equator, followed by a polar flow, a down-welling in the polar region, and an equatorward movement above the troposphere at approximately 24 km. In addition, a seasonal perturbation of this circulation occurs in the long winter night near the pole. This accumulation at high levels is broken up when the sun returns and the material is rapidly carried to the troposphere. The polar debris has a shorter residence than the equatorial debris. The residence times of material injected at these 2 sites respectively, permit a quantitative estimate of the intensity and depth of the circulation to be made. (Contractor's abstract, modified)

352

California U. Dept. of Engineering, Los Angeles.

STRESS FIELD CAUSED BY SLIPS IN A WORK-HARDENING CRYSTAL IN AN AGGREGATE, by T. H. Lin and D. Martin. Oct. 1960, 29p. incl. diagrs. refs. (Rept. no. 60-94) (AFOSR-TN-60-1256) (AF 49(638)20) AD 250368; PB 153723 Unclassified

The stress field of an aggregate of randomly-oriented crystals loaded just beyond the elastic limit is computed. The elastic modulus of each crystal is taken to be isotropic. The sliding directions and planes of different crystals are different. The initial stage of plastic deformation, at which only the most favorably orientated crystal slides, is considered. This sliding crystal is assumed to be of cubic shape and at the interior of a fine grained aggregate. The aggregate is infinitely large as compared to the crystal. It is shown that the plastic strain gradient is equivalent to body force in the calculation of stress field. The equivalent body force caused by slips in the sliding crystal is considered to apply in an infinite elastic isotropic medium. The known solution of the stress field caused by a concentrated force in an infinite medium is applied to express the stress components in terms of slip distributions in the sliding crystal. The increase of critical shear stress with slip caused by work hardening is considered. The resolved shear stress is equated to this critical shear stress in the sliding region. This gives an integral equation in terms of slips at different points. This equation is solved numerically by the method of finite difference. The stresses caused by these slips are then calculated and shown in graphs. These stresses caused by slips decrease rapidly with the distance from the sliding crystal. (Contractor's abstract)

353

California U. Dept. of Engineering, Los Angeles.

STRESS FIELD CAUSED BY A UNIFORMLY SLID CRYSTAL AT THE SURFACE OF AN AGGREGATE, by T. H. Lin and T. K. Tung. Oct. 1960, 48p. incl. diagrs. refs. (Rept. no. 60-98) (AFOSR-TN-60-1387) (AF 49-(638)20) AD 251878; PB 154362 Unclassified

Presented at West Coast Conf. of Appl. Mech., Seattle, Wash., Aug. 28-30, 1961.

Also published in Jour. Appl. Mech., v. 29: 523-532, Sept. 1962. (Title varies)

A uniform sliding is assumed to occur in a crystal of cubical shape and located at the free surface of a fine-grained polycrystalline aggregate. The face of the cube lies in the free surface. The sliding direction and the sliding plane are assumed to incline 45 degrees with both this top face and a vertical face of the cube. Uniform sliding gives uniform plastic strain in the cubic crystal. Plastic strain gradient is equivalent to body force in producing stress field. This uniform plastic strain in this cube gives equivalent uniform surface forces on the 4 faces of the cube. The stress field caused by these surface forces is calculated by means of Papkovitch functions, as given by Mindlin in calculating stresses caused by concentrated forces applied at the interior of a semi-infinite solid. Closed form solutions are obtained for all the stress components. The

discontinuity of some stress components across the faces of the cube is discussed. The distribution of stresses caused by this plastically deformed crystal in the aggregate is calculated and shown in graphs.

354

California U. Dept. of Engineering, Los Angeles.

ON THE ASSOCIATED FLOW RULE OF PLASTICITY BASED ON CRYSTAL SLIPS, by T. H. Lin. [1960] [10]p. incl. refs. (AFCSR-3628) (AF 49(638)20) Unclassified

Also published in Jour. Franklin Inst., v. 270: 291-300, Oct. 1960.

Associated flow rule has been commonly assumed in the limit analysis of metal structures. In this paper, aggregates of differently oriented metal crystals with finite elastic constants are considered. The coincidence of the plastic potential with yield surface of these polycrystalline aggregates is theoretically derived from the slip characteristics of single crystals. The deviation of the plastic potential from the yield surface of the aggregate increases with the elastic anisotropy of the individual crystals. (Contractor's abstract)

355

California U. Dept. of Engineering, Los Angeles.

ON THE OPTIMUM SYNTHESIS OF SAMPLED DATA MULTIPOLE FILTERS WITH RANDOM AND NON-RANDOM INPUTS, by H. C. Hsieh and C. T. Leondes. Feb. 1960 [42]p. incl. diagrs. (AFOSR-TN-60-440) (AF 49(638)438) AD 239646; PB 149170 Unclassified

Presented at I.R.E. Internat'l. Convention, New York, Mar. 21-24, 1960.

Also published in I.R.E. Internat'l. Convention Record, Part 4: 37-52, 1960.

The synthesis of optimum sampled data multipole filter with n inputs and m outputs is considered. The signal portion of each input is assumed to consist of a stationary random component and a polynomial with unknown coefficients but known maximum order. Each signal is corrupted by stationary random noise. The filter under investigation is linear, time invariant, and has finite memory. Each input to the filter consists of a sequence of impulses with a constant period T. Each impulse is assumed to have an area equal to the value of the signal plus noise at the samplin instant. The synthesis procedure to be developed is to specify the weighting functions of the filter such that the system error, which is defined as the difference between the actual and ideal outputs, has zero ensemble mean and the system ensemble mean square error is minimum. The weighting functions thus obtained will have, in general, abrupt jumps at the sampling instants but they are continuous within the sampling intervals. The synthesis procedure is extended to the case shown in Appendix A where each of the nonrandom signals can be expressed as an arbitrary linear combination of a set of known time functions. Further generalization is possible to the synthesis of time-varying filter with sampled nonstationary random inputs as given in Appendix B. (Contractor's abstract)

356

California U. Dept. of Engineering, Los Angeles.

EXTENSIONS IN SYNTHESIS TECHNIQUES FOR LINEAR SYSTEMS. PART II, by M. D. Schwartz. May 1960 [35]p. incl. diagrs. tables. (Rept no. 60-39) (AFOSR-TN-60-609) (AF 49(638)438) AD 241884; PB 150254 Unclassified

Extensions in synthesis techniques for linear control systems are presented for more general inputs and more general error criteria than were heretofore available in the control literature. It is shown that the error is chosen such that it is approximately the product of a constant and the derivative of the input.

357

California U. Dept. of Engineering, Los Angeles.

EXTENSIONS IN SYNTHESIS TECHNIQUES FOR LINEAR SYSTEMS. PART I, by M. D. Schwartz and C. T. Leondes. May 1960, 55p. incl. diagrs. tables. (Rept. no. 60-38) (AFOSR-TN-60-610) (AF 49(638)438) AD 241883; PB 150253 Unclassified

Synthesis techniques for linear control systems are presented, and methods are established for guarantying that the minimum size power actuator is selected in the synthesis procedure. An additional consideration introduced in the synthesis techniques presented is the minimization of the complexity of the required compensation networks.

358

California U. Dept. of Engineering, Los Angeles.

INCREMENTAL PHASE PLANE ANALYSIS OF NONLINEAR SECOND ORDER DIFFERENCE EQUATIONS, by R. A. Nesbit. Feb. 1960 [31]p. incl. diagrs. refs. (Rept. no. 60-28) (AFOSR-TN-60-616) (AF 49(638)438) AD 241885; PB 150251 Unclassified

The use of the incremental phase plane in the analysis of nonlinear difference equations is discussed. The variable and its first difference are the coordinates of this plane; for each point in the plane there is a unique solution to a second order difference equation. The relation between the trajectories in the incremental phase plane and in the ordinary phase plane is shown for

linear paired equations. An isocline method of graphically obtaining the solution to the difference equation is developed. An extension of the isocline method gives a set of curves tangent to the solution path, called path tangent curves. These curves allow convenient description of difference equation switching. Criteria for the determination of the stability of singular points in the incremental phase plane are given for both forms of the difference equation. For continuity of development, a synopsis of related material is presented. It is intended that these techniques may be applied to aid the design of nonlinear sample data systems.

359

California U. Dept. of Engineering, Los Angeles.

ON THE SYNTHESIS OF OPTIMUM MULTIPOLE FILTERS, by E. B. Stear. May 1960, 8p. incl. diagr. (Rept. no. 60-27) (AFOSR-TN-60-617) (AF 49(638)438) AF 241886; PB 150250 Unclassified

Research is concerned with the synthesis of linear, "least-squares", multipole filters. A class of criteria is discussed which can descriptively be called generalized quadratic error criteria. It is shown that the optimum multipole filter for any element of the class of criteria is also the optimum multipole filter for any other element of the class. The methods to be used in the proof of the above result are discussed and all random processes considered are, in general, assumed to be complex-valued. Real-valued random processes are thus included as a special case requiring only slight (and obvious) changes in notation.

360

California U. Dept. of Engineering, Los Angeles.

ON THE THEORY OF PROCESS ADAPTIVE CONTROL SYSTEMS, THE LEARNING MODEL APPROACH, by M. Margolis. May 1960 [132]p. incl. diagrs. table, refs. (Rept. no. 60-32) (AFOSR-TN-60-618) (AF 49-(638)438) AD 241887; PB 150252 Unclassified

The theory of feed-back control is extended to those systems that operate in a widely changing environment. The concept of a process adaptive control system using the learning model approach to determine the dynamic characteristics of the physical process is explored. The particular method devised for determining the dynamic characteristics of the process makes use of a learning model, and a mechanism for adjusting the parameters of the learning model. It is the function of the adjusting mechanism to so set the parameters of the model that the model will behave as much like the process as possible. Having adjusted the parameters of the model so that they adequately describe those of the process, the parameters may be used in the computing circuits of the programmer. The programmer then determines and sets the parameters of the controller according to the control laws devised by the system designer. The controller's parameters are adjusted so that the entire control system operates in a satisfactory manner despite adverse environmental conditions. The particular method for adjusting the parameters of the learning model is based on an approximation to the method of steepest descent. The equations describing the operation of the adjusting mechanism are derived and result in a nonlinear nonautonomous system. The stability and dynamic response of the learning mechanism are examined by both analytic methods and computer experiments. The learning mechanism was found capable of tracking the parameters describing the process for a wide variety of actuating signals. (Contractor's abstract)

361

California U. Dept. of Engineering, Los Angeles.

EXTENSIONS IN THE SYNTHESIS OF TIME OPTIMAL OR "BANG-BANG" NONLINEAR CONTROL SYSTEMS. PART I. THE SYNTHESIS OF QUASI-STATIONARY OPTIMUM NONLINEAR CONTROL SYSTEMS. by P. Chandaket and C. T. Leondes. June 1960, 38p. incl. diagrs. (Rept. no. 60-45) (AFOSR-TN-60-960, pt. I) (AF 49(638)438) AD 247423 Unclassified

Techniques were established for the synthesis of "bang-bang" or relay servos which result in an optimum nonlinear control system for the case where the system under control is of second order. The nonlinear controller utilizes a one-variable function generator in its realization. The concept of developing a controller based on the more important roots of the controlled system is examined. Emphasis is placed on designing controllers based on the two most important roots of a controlled system; these roots being treated as those closest to the origin. A control system designed so as to be optimum with this restriction is referred to as an optimum Type II control system. The scope and utility of this method are extended, and a number of significant results are obtained. The scope and utility of all these techniques in system design are demonstrated further by a number of analytical studies of these synthesis techniques. In particular, the dynamic response capabilities of systems synthesized by these techniques are studied for (1) position inputs; (2) combination of position and velocity inputs; (3) combination of position, velocity, and acceleration inputs; and (4) sinusoidal inputs. The results obtained show that these systems follow these inputs faithfully. (Contractor's abstract)

362

California U. Dept. of Engineering, Los Angeles.

EXTENSIONS IN THE SYNTHESIS OF TIME OPTIMAL OR "BANG-BANG" NONLINEAR CONTROL SYSTEMS. PART II. SYNTHESIS AND ANALYTIC STUDIES OF OTPIMUM TYPE II NONLINEAR CONTROL SYSTEMS, by P. Chandaket and C. T. Leondes. June 1960, 92p.

incl. diagrs. tables. (Rept. no. 60-46) (AFOSR-TN-60-960, pt. II) (AF 49(638)438) AD 247424 Unclassified

Synthesis techniques for optimum nonlinear control systems of the quasi-stationary class are developed wherein the controller configuration depends on a knowledge of certain information about the input to the system. The class of inputs for which system response is optimum is significantly extended. The synthesis techniques are developed in detail for second and third order systems with the techniques presented directly extendable to higher order systems. For systems of higher order than the second, there is the practical mechanization problem of requiring high order function generators in realizing the system. For example, for the third order system a function generator is required whose output is a function of two variables. Such a function generator is fairly complicated and expensive. Another technique which does not require an approximation to be made and which uses only single variable function generators is discussed. This may be viewed as a step in the direction toward the practical realization of optimum nonlinear control systems of third or higher order of the stationary or quasi-stationary types. (Contractor's abstract)

363

California U. Dept. of Engineering, Los Angeles.

EXTENSIONS IN THE SYNTHESIS OF TIME OPTIMAL OR "BANG-BANG" NONLINEAR CONTROL SYSTEMS. PART III. SYNTHESIS AND ANALYTIC STUDIES OF OPTIMUM TYPE II NONLINEAR CONTROL SYSTEMS WITH COMPLEX ROOTS, by P. Chandaket and C. T. Leondes. June 1960 [149]p. incl. diagrs. refs. (Rept. no. 60-47) (AFOSR-TN-60-960, pt. III) (AF 49(638)438) AD 246353; PB 153099 Unclassified

It is the purpose of this investigation to present the required phase space solution for the optimum nonlinear controller for second-order systems, and thus, to fill an important gap in the literature in the control systems field. The derivation of the required optimum nonlinear controller is a fairly involved process as this report demonstrates. The resultant controller is a fairly complicated device and it presents some practical problems in its mechanization; as a result some compromise optimum nonlinear controllers are presented. The report concludes with studies of the dynamic response capabilities of these systems. A variety of input forcing functions are applied to systems with optimum and compromised optimum nonlinear controllers, and their excellent response capabilities observed. (Contractor's abstract)

364

California U. Dept. of Engineering, Los Angeles.

NONSTATIONARY SIGNAL FLOW GRAPH THEORY, by E. B. Stear and A. E. Stubberud. Nov. 1960, 33p. incl. diagrs. (Rept. no. 60-64) (AFOSR-161) (AF 49-(638)438) AD 252813 Unclassified

The use of signal flow graphs to aid in the analysis of non-stationary systems is described. The problems which arise in the reduction of the flow graph are described; and techniques which can be used to aid in the reduction are developed, which are quite detailed when applied to specific systems. Operating on non-stationary systems is a complex process and no known general procedure provides the simplicity which can be obtained in the stationary case through the Laplace transformation. The techniques described are no more general than the techniques for the analysis of ordinary linear differential equations; their real advantage lies in the fact that the logical procedures of analysis which have been developed for stationary signal flow graphs can be extended to non-stationary signal flow graphs. (Contractor's abstract)

365

California U. Dept. of Engineering, Los Angeles.

ON THE OPTIMUM SYNTHESIS OF DISCRETE MULTIPOLE FILTERS WITH RANDOM AND NONRANDOM INPUTS, by H. C. Hsieh. Dec. 1960, 23p. incl. diagrs. (Rept. no. 60-106) (AFOSR-162) (AF 49(638)438) AD 253105 Unclassified

Consideration was given to the optimum synthesis of discrete filters with n inputs and m outputs. The signal portion of each input shall consist of a nonstationary random component and a nonrandom component which can be described by linear combination of some known functions. Each signal is corrupted by an additive nonstationary random noise. The synthesis criteria employed are that each system error, which is defined as the difference between the actual and ideal outputs, has zero ensemble mean and that each system ensemble mean square error is minimum. It is noticed that the synthesis procedure for this problem is very similar to that for a sampled data multipole continuous filter considered previously by the author. (Contractor's abstract)

366

California U. [Dept. of Physics] Los Angeles.

FORM INVARIANCE IN QUANTUM ELECTRODYNAMICS (Abstract), by D. L. Pursey and J. F. Plebanski. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)717] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 81, Jan. 27, 1960.

The principle of form invariance asserts that if a group of unitary transformations of a theory is equivalent to a group of transformations of c-number parameters, the predictions of the theory depend on the parameters only through quantities invariant under the group. This principle cannot be directly applied to the full 4-dimensional group of transformations of the Dirac electron theory described in a previous abstract, since not all of these transformations are unitary. The possibility of extending the form invariance principle to this theory will be discussed.

367

California U. [Dept. of Physics] Los Angeles.

INVARIANCE PROPERTIES OF THE DIRAC ELECTRON THEORY (Abstract), by J. F. Plebanski and D. L. Pursey. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)717] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 81, Jan. 27, 1960.

If the Dirac field operator is divided into its "left" and "right" components, and these are recombined in a new manner, then it is natural to interpret certain linear transformations of the new field components as Lorentz transformations in a fictitious 4-dimensional space. Gague transformations of the first kind of the original theory are rotations in a 2-dimensional space-like subspace. The Pauli transformations (e.g., of the neutrino field) are rotations in a 3-dimensional space-like subspace. The Dirac equations (but not the commutation rules) are invariant under transformations in a 3-dimensional subspace with signature (+ --). The Dirac equations and commutation rules can be made covariant under transformations in the 4-dimensional space provided suitable transformation properties are assigned to certain c-number parameters in the theory.

368

California U. Dept. of Physics, Los Angeles.

DETERMINATION OF THE FORWARD SCATTERING AMPLITUDE FROM THE OPTICAL-MODEL POTENTIAL IN THE HIGH-ENERGY LIMIT, by R. Lipps Seide and D. S. Saxon. [1960] [2]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-717] and National Science Foundation) Unclassified

Published in Phys. Rev., v. 120: 1458-1459, Nov. 15, 1960.

A relation between the two-particle forward scattering amplitude, $f_k(o)$, and the volume integral over the optical potential, $V_k(x)$, is given in the high energy limit, which is valid at least to second order in the two-body interactions, neglecting correlation and exchange terms. The relation is

$$\int V_k(x)dx = - (2\pi\hbar^2/m)A_k(o),$$

where A is the number of nucleons in the target, and m is the reduced mass of the two-particle system. The connection between the shape of the optical-model potential and the density distribution of the target nucleus is discussed. (Contractor's abstract)

369

California U. Dept. of Psychology, Santa Barbara.

BEHAVIORAL, ATTITUDINAL, AND PERCEPTUAL DIFFERENCES BETWEEN LEADERS AND NON-LEADERS IN SITUATIONS OF GROUP SUPPORT AND NON-SUPPORT, by P. S. Gallo and C. G. McClintock. [1960] [13]p. incl. tables, refs. (AFOSR-TN-60-374) (AF 49(638)794) Unclassified

Also published in Jour. Social Psychol., v. 56: 121-133, Feb. 1962.

A naive subject, either a leader or a nonleader, was placed in a group with 3 paid participants. These accomplices supported the subject in the 1st session, and withdrew this support in the 2nd. The results indicate leaders are more accurate in perceiving their status as leaders, initiate more task-oriented directive responses, and show more hostility when their position is threatened than do nonleaders. Leaders tend to show greater variability in behavior in the deprivation situation while nonleaders show more variable behavior in the support situation, suggesting variance decreased in familiar roles.

370

Cambridge Language Research Unit (Gt. Brit.).

SELF-ORGANIZATION AND THE NOTION OF LEVEL; A SUMMARY OF THREE DISCUSSIONS. [1960] [18]p. incl. diagrs. (AFOSR-291) (AF 61(052)331) AD 254297 Unclassified

Three of the discussions presented at the Tower Mill, Burnham Overy Staithe, Norfolk, and in Cambridge, September-October 1960 are reviewed. The subjects included the essential characteristics of a self-organizing system, a self-organizing machine, and a diagrammatic explanation of a system. The criteria suggested for a self-organizing machine are as follows: (1) It has at least one goal at any time; (2) It can change its structure as well as its state in producing its output; and (3) The output from a given stimulus is less complex than the changes in the machine resulting in that output.

371

Cambridge U. Cavendish Lab. (Gt. Brit.).

INTERMETALLIC PHASES IN THE ALUMINIUM-MANGANESE BINARY SYSTEM, by M. A. Taylor. [1959] [7]p. incl. illus. diagrs. tables, refs. (AFOSR-3818) (AF 61(052)50) Unclassified

Also published in Acta Metall., v. 8: 256-262, Apr. 1960.

The region of the aluminum-manganese phase diagram from 33 to 45 wt % manganese has been investigated by means of x-ray analysis, density measurements, and microsections. Two previously unknown metallic compounds have been isolated, and a third known phase shown to be stable only at high temperatures. Crystallographic and chemical studies of the various phases are described, and corrections to the published phase diagram are suggested. (Contractor's abstract)

372

Cambridge U. Cavendish Lab. (Gt. Brit.).

THE SPACE GROUP OF $MnAl_3$, by M. A. Taylor. [1960] [1]p. (AFOSR-3819) (AF 61(052)50) Unclassified

Also published in Acta Cryst., v. 14: 84, Jan. 1961.

The orthorhombic unit-cell dimensions were measured by x-ray rotation photographs and found to be: a = 14.79 ± 0.01, b = 12.42 ± 0.01, c = 12.59 ± 0.01A. Systematic absences were consistent with space groups $Pn2_1$ and Pnma. The intensity distributions in the three principal zones lie well above the normal centric distribution. The space group is therefore probably Pnma. Chemical analysis of the crystals gave a Mn content of 37.4 wt %, the density of the crystals was 3.90 ± 0.05 g/cm^3. The unit-cell contents are therefore approximately 36 Mn and 124 Al atoms. Rotation photographs about the b and c axis are very similar indicating a strong pseudo-tetragonality. Marked layer perpendicular to these axis is evident.

373

Cambridge U. Cavendish Lab. (Gt. Brit.).

X-RAY FLUORESCENCE METHOD FOR DETERMINATION OF THE TRANSITION-METAL CONTENT IN VERY SMALL SPECIMENS OF ALLOYS, by P. J. Brown. [1960] [4]p. incl. diagrs. table. (AFOSR-3820) (AF 61(052)50) Unclassified

Also published in Jour. Scient. Instr., v. 37: 394-397, Oct. 1960.

A method is described for the quantitative determination of the transition metal content in very small quantities of alloys containing transition metals of the first long period. The method depends upon measurement of the intensity of the fluorescent x-rays emitted by the specimen. The results are evaluated by comparison with a series of standards. An accuracy of better than 1% can be achieved in specimens containing as little as 0.2 mg of the transition metals. (Contractor's abstract)

374

Cambridge U. Cavendish Lab. (Gt. Brit.).

THE STRUCTURE OF α (Al-Cu-Fe), by P. J. Black, O. S. Edwards, and J. B. Forsyth. [1960] [6]p. incl. diagrs. tables, refs. (AFOSR-3821) (AF 61(052)50) Unclassified

Also published in Acta Cryst., v. 14: 993-998, Sept. 1961.

The structure of α(Al-Cu-Fe), isomorphous with $MnAl_6$, has been refined using two-dimensional projections. The centrosymmetric space group Ccmm was chosen, but the ellipticity of a number of the projected atomic peaks was considered to be too large to be the result of anisotropic thermal motion. The ellipticities are successfully explained in terms of a symmetry debasement to the noncentrosymmetric space group $Ccm2_1$, although it has not been possible to decide between alternative directions for the small atomic shifts which give rise to this symmetry debasement. (Contractor's abstract)

375

Cambridge U. Cavendish Lab. (Gt. Brit.).

THE STRUCTURE OF THE σ-PHASE Nb_2Al, by P. J. Brown and J. B. Forsyth. [June 1960] [9]p. incl. diagrs. table. (AFOSR-3822) (AF 61(052)50) Unclassified

Also published in Acta Cryst., v. 14: 362-364, Apr. 1961.

The σ-phase structure of Nb_2Al has been confirmed by making single-crystal measurements. The distribution of atoms in the available sites has been determined and the atomic parameters have been refined. The relationship of this structure to other σ-phases is discussed.

376

Cambridge U. Cavendish Lab. (Gt. Brit.).

EFFECT OF STRAIN-RATE ON THE FLOW-STRESS OF f.c.c. METALS, by P. B. Hirsch, T. E. Mitchell, and P. R. Thornton. Annual summary rept. no. 1. Oct. 1959 [41]p. incl. diagrs. tables, refs. (AFOSR-TN-60-152) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)98 and the British D.S.I.R.) AD 234224; PB 147335 Unclassified

Polycrystalline α brasses of 3 compositions (10, 20 and 30% Zn) and polycrystalline neutron irradiated Cu were studied as a function of deformation from 4.2° K to 300°K. Single crystals of pure Cu and of 70/30 α brass were also studied in the same manner. Results show that for alloys and irradiated Cu, in contrast to pure polycrystalline metals, the fractional change $\Delta\sigma/\sigma$ due to an increase in strain-rate is not independent of strain but decreases rapidly with increasing strain and becomes strain independent only at high strains. For single crystals the strain dependence of the quantity $kT\ln \frac{\epsilon_1/\epsilon_2}{\Delta\sigma/\sigma} = V\tau$ is given. For small strains $V\tau$ is small and independent of strain. As the strain is increased $V\tau$ increases rapidly with strain until at high strains it becomes strain-independent. (Contractor's abstract, modified)

377

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

PHYSICAL LIMITATIONS TO DISPERSION RELATIONS, by J. G. Taylor. Jan. 1960 [26]p. incl. diagrs. refs. (Technical scientific note no. 3) (AFOSR-TN-60-276) (AF 61(052)233) AD 234217; PB 146443 Unclassified

Also published in Ann. Phys., v. 10: 516-535, Aug. 1960. (Title varies)

An attempt is made to understand the limitations to the validity of dispersion relations by considering fourth order terms for elastic scattering in perturbation theory. For the exchange scattering of equal mass, scalar, neutral bosons, $\Delta^2_{max} = 2m^2$ is obtained for the limit of the validity of the general proof, but closer inspection shows that the dispersion relation is satisfied by this diagram for all values of the momentum transfer Δ. This is also the case for nucleon-nucleon exchange scattering. The general limitations on Δ^2 have arisen from natural examples, and the method of proof using analyticity in the mass of the projectile particle must be extended considerably to enable such examples to be considered. No general limitations on Δ^2 arise from the direct scattering term in fourth order, but do so when anomalous thresholds are allowed. (Contractor's abstract, modified)

378

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

THE ANALYTIC PROPERTIES OF PERTURBATION THEORY-I, by J. C. Polkinghorne and G. R. Screaton. Jan. 1960, 16p. incl. diagrs. refs. (Technical scientific note no. 4) (AFOSR-TN-60-277) (AF 51(052)233) AD 234223; PB 146442 Unclassified

Also published in Nuovo Cimento, Series X, v. 15: 289-300, Jan. 16, 1960.

A general method is given for locating the complex singularities of the contributions from Feynman diagrams regarded as functions of the external scalar products. The method is illustrated by application to the third-order vertex function. (Contractor's abstract)

379

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

SINGLE PARTICLE SINGULARITIES IN SCATTERING AND PRODUCTION AMPLITUDES, by J. Gunson and J. G. Taylor. Jan. 1960 [19]p. incl. diagrs. tables, refs. (Technical scientific note no. 5) (AFOSR-TN-60-278) (AF 61(052)233) AD 234216; PB 147619 Unclassified

Also published in Nuovo Cimento Series X, v. 15: 806-816, Mar. 1, 1960.

A proof of analyticity properties in momentum transfer of the amplitude for certain physical processes is given here. In particular the use is justified of extrapolation in the scattering angle, at a fixed angle, at a fixed energy, to obtain the pion-nucleon coupling constant from photoproduction data, for photon laboratory energies up to 1 bev. This extrapolation procedure to obtain strange particle parities and coupling constants is also justified for certain strange particle production and scattering processes. (Contractor's abstract)

380

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics, (Gt. Brit.).

UNSTABLE PARTICLES IN A GENERAL FIELD THEORY, by J. Gunson and J. G. Taylor. Feb. 1960, 11p. incl. diagrs. (Technical scientific note no. 6) (AFOSR-TN-60-679) (AF 61(052)233) AD 240347; PB 149587 Unclassified

Also published in Phys. Rev., v. 119: 1121-1125, Aug. 1, 1960.

The problem of unstable particles in quantum field theory is treated as one of the interpretation of complex singularities appearing in the analytic continuation of scattering amplitudes into unphysical sheets of their Lorentz invariant variables. Suitable continuations are shown to hold under certain restrictive assumptions in a general field theory, making use of unitarity and causality of the S-matrix. The extra singularities appearing in the continuation are fixed isolated poles, in accordance with a conjecture of Peierls. (Contractor's abstract)

381

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

SOME PROPERTIES OF SINGLE LOOP DIAGRAMS IN PERTURBATION THEORY, by M. Fowler, P. V. Landshoff, and R. W. Lardner. May 1960 [10]p. incl. diagrs. (Technical scientific note no. 7) (AFOSR-TN-60-728) (AF 61(052)233) AD 242235; PB 150342
Unclassified

Also published in Nuovo Cimento, Series X, v. 17: 956-963, Sept. 16, 1960.

Methods are summarized for finding singularities of a contribution to the S-matrix for a Feynman diagram in perturbation theory, with reference to single-loop diagrams. They are then applied to the third order vertex function and to an extension of the work of Tarski on scattering in fourth order, with internal stability conditions relaxed. The results for the vertex function are used to show that the S-matrix for production processes does not have a two-variable spectral representation. The leading singularities for the fifth order contribution to single pion-production in π-N scattering are shown not to produce anomalous thresholds. (Contractor's abstract)

382

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

A DISCUSSION OF DUAL DIAGRAMS IN PERTURBATION THEORY, by P. V. Landshoff. May 1960 [10]p. incl. diagrs. (Technical scientific note no. 8) (AFOSR-TN-60-729) (AF 61(052)233) AD 242229; PB 150343
Unclassified

Also published in Nuclear Phys., v. 20: 129-135, Oct. 1960.

A discussion is given of the dual diagram method of finding singularities corresponding to a contribution to the S-matrix from a Feynman graph in perturbation theory. It is shown that it may be necessary to draw the dual diagram in a space of greater dimensions than that spanned by the external momentum vectors of the Feynman graph, but that this possibility does not affect previous conclusions concerning anomalous thresholds in vertex parts. The effects are considered of the dimensionality of space on the singularities for processes involving many external particles. (Contractor's abstract)

383

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

LOW ENERGY PION SCATTERING, by J. Hamilton and T. D. Spearman. June 1960 [40]p. incl. diagrs. tables, refs. (Technical scientific note no. 9) (AFOSR-TN-60-1081) (AF 61(052)233) AD 244245
Unclassified

Partial wave dispersion relations are used to investigate low energy s-wave pion-nucleon scattering. The various terms in the relations are examined. It is shown that the Born terms are very small, and the remaining terms are of the same order of magnitude as the observed scattering amplitudes. The evidence for a low energy pion-pion interaction from s-wave pion-nucleon scattering is discussed. A comparison of the dispersion relations, for s- and p-wave partial amplitudes is made. (Contractor's abstract)

384

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

THE COMPLEX SINGULARITIES OF PARTIAL-WAVE AMPLITUDES IN PERTURBATION THEORY, by J. G. Taylor and A. E. A. Warburton. June 1960, 3p. incl. diagrs. (Technical scientific note no. 10) (AFOSR-TN-60-1082) (AF 61(052)233) AD 244244
Unclassified

Also published in Phys. Rev., v. 120: 1506-1507, Nov. 15, 1960.

The complex singularities which invalidate Mandelstam's representation (Phys. Rev., v. 112: 1344, 1958) are shown not to cause complex singularities of partial-wave amplitudes. This result is of importance in that the most useful analyticity property for scattering amplitudes is, in practice, a cut plane of analyticity for the partial-wave amplitudes. There may also be expected kinematic complex branch points if the outgoing particles differ from the incoming particles.

385

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

SOME SINGULARITIES OF SCATTERING AMPLITUDES ON UNPHYSICAL SHEETS, by J. Gunson and J. G. Taylor. July 1960 [10]p. incl. diagrs. (Technical scientific note no. 11) (AFOSR-TN-60-1083) (AF 61(052)233) AD 244458
Unclassified

Also published in Phys. Rev., v. 121: 343-346, Jan. 1, 1961.

An investigation of the consequences on unphysical sheets of a Mandelstam type representation holding for a 2-particle scattering amplitude on the physical sheet is described. The domain of analyticity in the energy and momentum transfer variables is constructed and compared with perturbation theory. A theorem on multiplication of singularities for Legendre polynomial expansions used in the discussion is proved.

386

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

UNITARITY AND THE MANDELSTAM REPRESENTATION, by R. W. Lardner. July 1960 [16]p. incl. diagrs. (Technical scientific note no. 12) (AFOSR-TN-60-1084) (AF 61(052)233) AD 244246 Unclassified

Also published in Nuovo Cimento, Series X, v. 19: 77-89, Jan. 1, 1961.

The three- and four-particle terms in the unitarity equation for the scattering amplitude satisfy the Mandelstam representation, on the assumption that the five- and six-point processes satisfy single dispersion relations. This result is independent of any perturbation theory calculations.

387

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

ON THE POSSIBLE EXISTENCE OF DOUBLY STRANGE HEAVY MESONS, by J. C. Polkinghorne and A. Salam. [1959] [2]p. [AF 61(052)233] Unclassified

Published in Nuovo Cimento, Series X, v. 15: 166-167, Jan. 1, 1960.

Production reactions, thresholds and decay processes are discussed for ω-mesons of S = 2 and mass $\sim 1500 m_e$.

Their existence would fill all the gaps in the four-dimensional scheme for mesons. This leads to the speculation that the (0,1) baryon triplet exists and to a discussion of the properties of its members.

388

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

THE ANALYTIC PROPERTIES OF PERTURBATION THEORY-II, by J. C. Polkinghorne and G. R. Screaton. [1960] [7]p. [AF 61(052)233] Unclassified

Published in Nuovo Cimento, Series X, v. 15: 925-931, Mar. 16, 1960.

The definition of the physical sheet of a perturbation theory function is discussed. The types of singularity near a given surface of singularity are investigated and an expression obtained for a leading singularity. The application of these ideas to the Mandelstam representation and to further problems is indicated. (Contractor's abstract)

389

Cambridge U. Dept. of Zoology (Gt. Brit.).

THE EFFECT OF OESTROGEN AND PROGESTERONE ON THE NEST-BUILDING OF DOMESTICATED CANARIES, by R. P. Warren and R. A. Hinde. [1959] [5]p. incl. tables, refs. (AFOSR-TN-60-1315) [AF 61-(052)97] AD 246163 Unclassified

Also published in Animal Behav., v. 7: 209-213, July-Oct. 1959.

Female canaries were injected with various levels of oestrogen and of oestrogen in combination with progesterone. Doses of oestrogen from 0.1 to 0.3 mg three times weekly had a negligible effect on building behavior. Doses of 0.5 three times weekly were toxic to some, but produced active nest-building in others. No enhancement or inhibition of the effect of oestrogen by progesterone was found in the dose combinations used. Progesterone alone did not maintain building behavior previously induced by oestrogen. Doses of 0.5 mg oestrogen induced nesting in some males.

390

Cambridge U. Dept. of Zoology (Gt. Brit.).

THE EFFECT OF NEST BUILDING ON LATER REPRODUCTIVE BEHAVIOUR IN DOMESTICATED CANARIES, by R. A. Hinde and R. P. Warren. [1958] [7]p. incl. diagrs. tables. (AFOSR-TN-60-1316) [AF 61(052)-97] AD 246164 Unclassified

Also published in Animal Behav., v. 7: 35-41, Jan.-Apr. 1959.

Domesticated canaries were subjected to various degrees of deprivation of nest-material and nest-site in order to determine the effects of nest building activity and the construction of a nest on later reproductive behavior. Those birds which had material continuously, but were not permitted to construct a nest, built more actively than those allowed to build undisturbed. Birds without material for most of the time built vigorously during the watches with material, but seldom visited the nest pan at other times. Birds without a nest-pan showed active building behavior but it was limited to the early phases of the nest building sequence. Egg laying was delayed in the birds deprived of material, and even further delayed in those also deprived of a nest pan probably because stimulation from the nest pan during building normally accelerates egg laying. The effects of the treatment on courtship feeding, the laying of clutches as opposed to single eggs, and incubation behavior are also discussed.

391

Cambridge U. Psychological Lab. (Gt. Brit.).

THE EFFECTS OF FRONTAL LESIONS AND NITROUS OXIDE ON THE TIMING BEHAVIOUR OF MONKEYS AND THE EFFECTS OF LIMITED LESIONS OF THE STRIATE CORTEX ON THE VISUAL BEHAVIOUR OF MONKEYS, by L. Weiskrantz. Annual summary rept. no. 2. Dec. 31, 1960 [4]p. (AFOSR-TN-60-712) (AF 51(052)185) AD 253777; PB 155530 Unclassified

A review of recent experiments concerning timing behavior and visual behavior of monkeys is presented. Some of the topics discussed are: the finding of an auditory discrimination learning deficit in frontal monkeys; discrimination between two pairs of stimuli each of which is separated by a time interval so the animal is forced to rely on his memory for discrimination; and a method for measuring past-pointing which confirms the observation that there is a transient period of 4-7 days in which past-pointing is exhibited immediately following a bilateral macular striate lesion.

392

Cambridge U. Psychological Lab. (Gt. Brit.).

STIMULATION OF FRONTAL CORTEX AND DELAYED ALTERNATION PERFORMANCE IN THE MONKEY, by L. Weiskrantz. Dec. 2, 1959 [8]p. incl. illus. tables. (Technical scientific note no. 2) (AFOSR-TN-60-913) (AF 61(052)185) AD 244824 Unclassified

Also published in Science, v. 131: 1443-1444, May 1960.

Unilateral or bilateral stimulation of the region surrounding the sulcus principalis of the cortex of the monkey interferes with delayed alternation performance. It is without effect on auditory discrimination performance. Bilateral stimulation is more disrupting than unilateral stimulation. The impairment is limited in time to the period of stimulation and is fully reversible.

393

Carnegie Inst. of Tech., Pittsburgh, Pa.

HALL EFFECT AND RESISTIVITY OF Ni-Pd ALLOYS, by J. A. Dreesen and E. M. Pugh. [1960] [6]p. incl. diagrs. refs. (AF 49(638)257) Unclassified

Published in Phys. Rev., v. 120: 1218-1223, Nov. 15, 1960.

Two Hall coefficients and the resistivity of Ni-Pd alloys have been measured from 4°K to room temperature using fields up to 3.1 webers/in^2. The ordinary Hall coefficient is found to decrease in magnitude for small additions of Pd in Ni, but to increase as more Pd is added. It is also found that the ordinary Hall coefficient varies more slowly with composition for these alloys than it does for the Ni-Cu alloys. It is shown that a simple treatment successfully correlates the ordinary Hall coefficient, the resistivity, and the saturation magnetization of these alloys. The results indicate that the parallel half of the d band in pure Ni is not quite full at the absolute zero of temperature, and that the relaxation time is not a function only of the energy for the thermal scattering in these alloys. The extraordinary Hall coefficient is found to obey none of the variously proposed theoretical relations.

394

Carnegie Inst. of Tech. Dept. of Civil Engineering, Pittsburgh, Pa.

FRACTURE ARREST BY RIVETED STIFFENERS, by J. P. Romualdi and P. H. Sanders. Final rept. Oct. 1960 [106]p. incl. illus. diagrs. tables, refs. (AFOSR-TR-60-174) (AF 49(638)237) AD 251014; PB 171268 Unclassified

The static relationships for the stresses near the tip of a crack lying in a field of uniform tension and the stresses near rivet forces in a plate both in the presence and in the absence of a crack are valid as described in this report. The conditions governing the onset of rapid fracture are completely defined for a plane stress situation. In addition, experiments of fracture onset in certain alloys of aluminum result in G_c values with very little scatter, providing the tests are made on identical specimens. The conditions governing the arrest of a moving crack may be represented by $\int_{a_1}^{a_2} [G - G_c]\,da = C$ where a_1 and a_2 are 1/2 the crack lengths at onset and arrest, respectively, and $G < G_c$ where G is the dynamic rate of release of stored elastic energy and G_c is the plastic work needed to create a unit area of crack. Both equations are applicable to straight and curved cracks.

395

Carnegie Inst. of Tech. [Dept. of Mathematics] Pittsburgh, Pa.

A MATHEMATICAL THEORY OF THE MECHANICAL BEHAVIOR OF CONTINUOUS MEDIA, by W. Noll. [1958] [29]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1138 and National Science Foundation under NSF-G5250) Unclassified

Published in Arch. Rational Mech. and Anal., v. 2: 197-226, 1958.

The basis of this report is the principle of determinism for the stress, which is implicit in all physical experience and applies to any material as long as only its

mechanical behavior is considered and as long as there are no constraints. From this principle and the principle of objectivity the most constitutive equation for all materials is derived. Concepts are developed which describe the local behavior of a motion at a particular particle since material properties are of a local nature and may change from particle to particle in a body. A detailed discussion of the theory of simple materials is given which includes new and very general definitions of isotropic and anisotropic solids and of fluids in terms of the special invariances of the corresponding constitutive equations.

396

Carnegie Inst. of Tech. Dept. of Mathematics, Pittsburgh, Pa.

NOTE ON POLYHARMONIC FUNCTIONS, by R. J. Duffin and Z. Nehari. Mar. 1960 [9]p. (AFOSR-TN-60-328) (Sponsored jointly by Air Force Office of Scientific Research as technical rept. no. 32 under AF 49-(638)227 and Office of Ordnance Research as technical rept. no. 44 under DA 36-061-ORD-490) AD 235374; AD 247276 Unclassified

Also published in Proc. Amer. Math. Soc., v. 12: 110-115, Feb. 1961.

The following theorem is proved: If u(P) is a non-negative polyharmonic function of order n in the m-dimensional sphere $\overline{OP} = r < R$, then

$u(P) \leq AR^{m-2}\frac{(R+r)}{(R-r)^{m-1}}$. If a function is both harmonic and positive then according to a classical inequality of Harnack the rate of growth of the function is limited. A similar inequality is found for function which is polyharmonic and positive in a region. If the region is the whole plane then this inequality yields a simple proof of the theorem of Nicolesco to the effect that the function is a polynomial. (Contractor's abstract)

397

Carnegie Inst. of Tech. Dept. of Mathematics, Pittsburgh, Pa.

INTEGRAL REPRESENTATIONS OF AXIALLY SYMMETRIC POTENTIAL FUNCTIONS, by R. C. MacCamy. Sept. 1960 [24]p. (Technical rept. no. 33) (AFOSR-TN-60-1092) (AF 49(638)227) Unclassified

This paper concerns solutions of elliptic partial differential equations in 3 variables when there is present an axis of symmetry. The simplest example is Laplace's equation in x, y, and z. Solutions which are symmetric about the z-axis are then functions, u(r,z) of z and $r^2 = x^2 + y^2$ which satisfies the equation, $u_{rr} + \frac{1}{r}u_r + u_{zz} = 0$. The present report clarifies some expressions of a previous report (CAR.09:004, Vol. II).

398

Carnegie Inst. of Tech. Dept. of Psychology, Pittsburgh, Pa.

ACQUISITION OF PERCEPTUAL RESPONSES AS A FUNCTION OF LOADING, LOCATION, AND REPETITION, by H. W. Karn and L. W. Gregg. [1960] [8]p. incl. diagrs. tables. (AFOSR-TN-60-507) (AF 49(638)-770) AD 263242 Unclassified

Also published in Jour. Exper. Psychol., v. 62: 62-69, 1961.

The ways perceptual responses are acquired by providing precise control over the nature of learnable cues and conditions of detection are determined. Three circles located at the points of an imaginary equilateral triangle were simultaneously presented to subjects on a screen by means of a tachistoscope with instructions to report the presence or absence of a dot within each circle. The experimental subjects received 60 presentations at .1 sec exposure following either 0, 10, 20, or 30 preliminary presentations at 1 sec. There was a significant reduction in errors as a function of the preliminary 1-sec presentations under all conditions of loading and location. (Loading refers to complete presence, complete absence or random occurrence at a location.) But both location and loading influenced the magnitude of the error, and there was a significant interaction between loading and location.

399

Carnegie Inst. of Tech. Metals Research Lab., Pittsburgh, Pa.

THE BREAKDOWN OF THE PROTECTIVE OXIDE FILM ON TRANSITION METAL ALLOYS, by W. W. Smeltzer. [1959] [3]p. incl. illus. diagrs. (AFOSR-TN-60-205) (AF 18(600)1572) AD 248089 Unclassified

Also published in Acta Metall., v. 8: 268-270, Apr. 1960.

From former experiments it is reasonable to assume that the oxidation characteristics of transition metal alloys are determined partially by the non-ideal thermodynamic behavior of the alloying constituents. However, available results for the oxidation resistant Ni-Cr and Fe-Cr steels cannot be analyzed in accordance to this consideration since the oxidation curves are discontinuous. It is the aim of this investigation to demonstrate that initial breaks in oxidation curves of Fe-Cr alloys are associated with the ferritic-austenitic phase transformation in the alloy. This transformation is caused by preferential oxidation of Cr at a rate much larger than its replenishment of diffusion to the metal-oxide interface. Continuous oxidation curves for Fe-Cr alloys may be obtained under experimental conditions where

preferential oxidation of an alloy constituent does not cause the ferritic-austenitic phase transformation. These curves may be analyzed to test the hypothesis that the oxidation resistance of Fe-Cr steels is determined partially by negative deviations of the alloy constituents from ideal thermodynamic behavior.

400

Case Inst. of Tech. [Dept. of Chemistry] Cleveland, Ohio.

NEW ALUMINUM PHTHALOCYANINES, by J. E. Owen and M. E. Kenney. [1960] [6]p. (AFOSR-TN-60-556) (AF 49(638)773) Unclassified

A number of aluminum phthalocyanines, in which the phthalocyanine ring has been maintained fixed and different groups have been substituted on the third valence of the aluminum, have been studied. These compounds include hydroxyaluminum phthalocyanine, oxyaluminum phthalocyanine, phenoxyaluminum phthalocyanine, p-phenylphenoxyaluminum phthalocyanine, p-methoxyphenoxyaluminum phthalocyanine and triphenylsiloxyaluminum phthalocyanine. An attempt has been made to determine the effects of the aluminum-bonded groups on the chemical and physical properties of the compounds and to correlate and interpret these effects in terms of the nature and spatial distribution of the bonds.

401

Case Inst. of Tech. [Dept. of Chemistry] Cleveland, Ohio.

PHTHALOCYANINOALUMINUM COMPOUNDS, by J. E. Owen and M. E. Kenney. [1960] [3]p. incl. diagrs. tables. (AFOSR-1585) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)773 and Esso Foundation) Unclassified

Presented at 138th Nat'l. meeting of the Amer. Chem. Soc , New York, Fall 1960.

Also published in Jour. Inorg. Chem., v. 1: 331-333, May 1962.

A group of phthalocyaninoaluminum compounds in which organo- and organo-siloxy groups have been bonded to the central aluminum atom are prepared and studied. These compounds illustrate some types of groups that can replace the simple inorganic groups which are ordinarily attached to the metal. Other characteristics of these compounds include their stability to heat under vacuum and their solubility ranging from low to almost zero in dimethylformamide, pyridine, ethanol, and 1-chloronaphthalene at room temperature.

402

Case Inst. of Tech. [Dept. of Physics] Cleveland, Ohio.

LOW FIELD DE HAAS-VAN ALPHEN STUDIES OF THE FERMI SURFACE OF MAGNESIUM, by W. L. Gordon, A. S. Joseph, and T. G. Eck. [1960] [4]p. incl. diagrs. (AFOSR-3413) (AF 49(638)621) Unclassified

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 149, Mar. 21, 1960. (Title varies)

Also published in Proc. Internat'l. Conf. on the Fermi Surface of Metals, Cooperstown, N. Y. (Aug. 22-24, 1960), New York, Wiley and Sons, 1960, p. 84-87. (AFOSR-395)

A null deflection torsion method permitting automatic recording of torque as a function of 1/H has been employed to study the de Haas-van Alphen oscillations in the magnetic susceptibility of single crystals of magnesium in fields up to 18 kgauss and at temperatures of 4.2°K and below. Analysis of the angular dependence of the de Haas-van Alphen periods on field orientation relative to crystalline axes has yielded extremal cross sections of the Fermi surface which agree closely with portions of the free electron construction proposed by W. A. Harrison. Although neither the 0002 nor 10$\bar{1}$1 face overlaps were observed, this merely indicates a lower limit to their minimum cross section of approximately $0.12A^{-2}$ imposed by the sensitivity of the apparatus. (Contractor's abstract)

403

Case Inst. of Tech. [Dept. of Physics] Cleveland, Ohio.

LOW FIELD DE HAAS-VAN ALPHEN STUDIES OF THE FERMI SURFACE OF MAGNESIUM (Abstract), by W. L. Gordon, A. S. Joseph, and T. G. Eck. [1960] [1]p. [AF 49(638)621] Unclassified

Presented at meeting of the Amer. Phys. Soc., Ohio State U., Columbus, Oct. 28-29, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 92, Feb. 1, 1961.

A null deflection torsion method permitting automatic recording of torque as a function of 1/H has been employed to study the de Haas-van Alphen oscillations in the magnetic susceptibilty of single crystals of magnesium in fields up to 19 kgauss and at temperatures of 4.2°K and below. Analysis of the angular dependence of the deHaas-van Alphen periods on field orientation relative to crystalline axes has yielded extremal cross sections of the Fermi surface which agree closely with portions of the free electron construction proposed by W. A. Harrison (Phys. Rev., v. 118: 1190, 1960).

404

Case Inst. of Tech. Statistical Lab., Cleveland, Ohio.

THE USE OF SAMPLE QUASI-RANGES IN SETTING CONFIDENCE INTERVALS FOR THE POPULATION STANDARD DEVIATION, by F. C. Leone, Y. H. Rutenberg, and C. W. Topp. Mar. 1960, 19p. incl. tables. (AFOSR-TN-60-408) (AF 49(638)361) AD 235950; PB 146872 Unclassified

Also published in Jour. Amer. Statist. Assoc., v. 56: 260-272, June 1961.

The choice of an optimal selection method of quasi-ranges for setting one-sided confidence bounds and confidence intervals for the standard deviation from a given distribution is discussed. The proposed methods of optimal selection are applied to random ordered samples from normal, exponential and rectangular distribution. Tables of confidence bounds for the standard deviation of these distributions are given for confidence levels commonly used in statistical work. These are compared with the results of standard procedures. (Contractor's abstract)

405

Case Inst. of Tech. Statistical Lab., Cleveland, Ohio.

ORDER STATISTICS AND ESTIMATORS FOR THE WEIBULL DISTRIBUTION, by F. C. Leone, Y. H. Rutenberg, and C. W. Topp. Mar. 1960, 25p. incl. tables, refs. (Rept. no. 1026) (AFOSR-TN-60-489) (AF 49(638)361) AD 237042; PB 147747 Unclassified

The properties of the generalized Weibull distribution $F(x) = 1-\exp[-((x - a)/b^c]$ are studied followed by a discussion of the order statistics from the distribution. Formulas and computational techniques for order statistics are derived. A number of approximation formulas are presented and compared with exact values. Properties of the distributions of the smallest and largest order statistics are studied. Problems of estimation of parameters are also dealt with. The method of maximum likelihood, as applied to the Weibull distribution, is studied. A number of estimators are given for various cases depending on which of the three parameters of the generalized distribution are assumed to be known. (Contractor's abstract)

406

Case Inst. of Tech. Statistical Lab., Cleveland, Ohio.

PERCENTILES OF THE BINOMIAL DISTRIBUTION, by F. C. Leone, G. E. Hyman and others. June 1960 [36]p. incl. tables, refs. (Rept. no. 1030) (AFOSR-TN-60-620) [AF 49(638)361] AD 239715; PB 149078 Unclassified

Tables of percentiles of the binomial distribution for sample sizes n = 10(5)100 and α = 0.0025, 0.005, 0.01, 0.025, 0.05, 0.1, 0.9, 0.95, 0.975, 0.99, 0.995 and 0.9975 are presented. A discussion is given of the methods of evaluating percentage points of the binomial distribution, including the use of these and other related statistical tables. Some applications of the tables are mentioned including sampling and life-testing problems and an example of the use of the tables in theoretical work. (Contractor's abstract)

407

Case Inst. of Tech. Statistical Lab., Cleveland, Ohio.

ESTIMATION OF SAMPLE SIZE, by N. L. Johnson. Nov. 1960 [17]p. incl. tables. (Case Computing Center publ. no. 1038) (AFOSR-28) (AF 49(638)361) AD 249551; PB 154237 Unclassified

Several methods of estimating the total number of individuals in a sample are discussed. These methods include discriminant analysis, maximum likelihood, and confidence intervals. Special attention is given to the case in which the r smallest values in the sample are known as well as the population distribution of the observed character. In this instance, it is shown that the largest of the observations is a sufficient statistic for the sample size. To attain a specified accuracy in distinguishing between two sample sizes n_0, n_1, where $n_1/n_0 = k$, it is found that the required value of r approaches a finite limit (depending on k and the required accuracy) as n_0, n_1 approach infinity. (Contractor's abstract, modified)

408

Catholic U. of America. [Dept. of Chemistry] Washington, D. C.

AN LCAO STUDY OF Be_2, by R. Hampson and J. S. Dooling. [1960] [21]p. incl. diagrs. tables. (AFOSR-TN-60-91) [AF 18(600)1537] AD 251723; PB 154987 Unclassified

Calculations were made in order to study the interaction of two Be atoms as related to crystal formation; to see the effect of including $2p\sigma$ atomic orbitals in the calculation; and to see whether the calculation of an excited-state would exhibit binding. The results of these 3 calculations are tabulated.

409

Catholic U. of America. [Dept. of Chemistry] Washington, D. C.

A MOLECULAR ORBITAL STUDY OF HYDROGEN

SUPEROXIDE, by R. Furlong and V. Griffing. [1960] 20p. incl. diagr. tables, refs. (AFOSR-TN-60-92) [AF 18(600)1537] AD 282344 Unclassified

The radical HO_2 was established as an intermediate in the hydrogen-oxygen reaction. The radical configuration is considered as that of an isosceles triangle with the O-H distance of 1.8A and the O-O distance of 2.456A. Electron states are described by molecular orbitals. For a given geometrical configuration of atoms, an attempt was made to determine the total energy of its ground state, the energy levels of its ground state, the promotion of charge in each of the atoms involved, the bonding properties of the various orbitals, the approximate energy of the lower-lying excited states. A correlation of these results with those for the oxygen molecule is presented. The calculations involve several assumptions.

410

Catholic U. of America. [Dept. of Chemistry] Washington, D. C.

A THEORETICAL INVESTIGATION OF THE EXCITED STATES OF LINEAR H_3, by H. L. Morrison and V. Griffing. [1960] 17p. incl. diagrs. tables. (AFOSR-TN-60-734) (AF 18(600)1537) AD 248887; PB 153828 Unclassified

An attempt was made to ascertain information regarding the excited states of the linear symmetric H_3 molecule. Previous work revealed the necessity for considering excited states in explaining the hyperfine structure measurements. It was speculated that a symmetrical excited state of H_3, in which the unpaired electron exists in an orbital constructed as a linear combination of 2s hydrogen atomic orbitals, might exhibit metastability. Hence, the explicit calculation of electronic states that can be constructed from a linear combination of 1s atomic orbitals for the doubly occupied orbital and linear combinations of 2s and 2p atomic orbitals for several singly occupied excited orbitals. The variation of the total energy of H_3 was studied as a function of the internuclear distance for 3 electronically excited states. Also, the extent of perturbation of the closed shell orbital by the excited singly occupied orbital is estimated.

411

Catholic U. of America. [Dept. of Chemistry] Washington, D. C.

AN LCAO MO SCF STUDY OF THE ELECTRONIC STATES OF SEVERAL LINEAR HYDROGEN COMPLEXES, by A. R. Ruffa and V. Griffing. [1960] 17p. incl. diagrs. tables. (AFOSR-TN-60-735) (AF 18(600)-1537) AD 248888; PB 153829 Unclassified

Theoretical calculations were made of the potential energy curves of several linear hydrogen complexes. The calculation was made according to the LCAO MO SCF method of Roothaan (Rev. Modern Phys., v. 23: 68-69, 1951). The results indicate that the hydrogen bimolecular exchange does not take place through an intermediate metastable 4 atom complex since the energy curves of such complexes have no minima and exhibit energies higher than that of other possible configurations. The complete reaction appears to be a continuous transition in which the interatomic distance of the approaching molecules increase, eventually forming a hydrogen molecule from the inner 2 hydrogen atoms and expelling the 2 outer hydrogen atoms.

412

Catholic U. of America. Dept. of Chemistry, Washington, D. C.

EXCESS FREE ENERGY IN DEHYDROGENATED PALLADIUM, by J. M. Singer and G. W. Castellan. [1960] [2]p. incl. table. (AFOSR-TN-60-411) [AF 49-(638)475] AD 243723 Unclassified

Also published in Jour. Chem. Phys., v. 33: 633-634, Aug. 1960.

"Untreated" Pd is more noble by 0.02 v than either the gas-charged or the electrolytically-charged metal. This difference shows that a distortion free energy of about 900 cal/mol remains in the metal after it is charged with hydrogen and then dehydrogenated. The rate of removal of hydrogen from the gas-charged alloy by ceric sulphate may be more than five times slower than the rate of removal from the electrolytically-charged alloy.

413

Catholic U. of America. [Dept. of Chemistry] Washington, D. C.

CHARACTERISTIC FUNCTIONS AND PARAMETERS IN THE THEORY OF HYDROGEN OVERPOTENTIAL. III. GENERAL CONSIDERATIONS, by G. W. Castellan. [1960] [3]p. (AFOSR-TN-60-1416) [AF 49(638)475] Unclassified

Published in Jour. Electrochem. Soc., v. 108: 686-688, July 1961.

It is shown that the characteristic functions suggested in another paper by Castellan (see item no. 414) on the basis of the Langmuir isotherm are useful for any isotherm. The concept of a characteristic function is generalized somewhat in a function $1/\Sigma$. The properties of $1/\Sigma$ are discussed. The effect of the logarithmic isotherm on the position of the curves is described. It is shown that ρ measures the variation of adsorption affinity with η near $\eta = 0$. (Contractor's abstract)

414

Catholic U. of America. [Dept. of Chemistry] Washington, D. C.

CHARACTERISTIC FUNCTIONS AND PARAMETERS IN THE THEORY OF HYDROGEN OVERPOTENTIAL. I. THEORETICAL, by G. W. Castellan. [1960] [6]p. incl. table. (AFOSR-3289) [AF 49(638)475] Unclassified

Published in Jour. Electrochem. Soc., v. 108: 277-282, Mar. 1961.

It is shown that the current density-overpotential relationship for several mechanisms of the hydrogen evolution reaction can be expressed conveniently in terms of one or the other of two characteristic functions:

$$g_1 = \left\{\exp\left[\left(a - \tfrac{1}{2}\right)\eta\right]\sinh\left(\tfrac{1}{2}\eta\right)\right\}\Big/ i, g_2 = \left[\tanh\left(\tfrac{1}{2}\eta\right)/i\right]^{\frac{1}{2}}.$$

The following parameters are convenient: a, the transfer coefficient for the oxidation reaction; θ_0, the fraction of the surface covered by H atoms at equilibrium, $i_0 = (di/d\eta)_{\eta=0}$; and $\rho = [d \ln [\theta/(1-\theta)]/d\eta]_{\eta=0}$. In the important special cases, the appropriate characteristic function is a simple function of the overpotential over the entire range of anodic and cathodic values. The evaluation of the parameters involved is discussed. (Contractor's abstract)

415

Catholic U. of America. [Dept. of Chemistry] Washington, D. C.

CHARACTERISTIC FUNCTIONS AND PARAMETERS IN THE THEORY OF HYDROGEN OVERPOTENTIAL. II. INTERPRETATION OF SOME MEASUREMENTS OF HYDROGEN OVERPOTENTIAL ON PALLADIUM, by G. W. Castellan. [1960] [4]p. incl. diagrs. tables. (AFOSR-3290) [AF 49(638)475] Unclassified

Published in Jour. Electrochem. Soc., v. 108: 282-285, Mar. 1961.

The hydrogen overpotential measurements of Hoare and Schuldiner on β-palladium in acid solutions can be interpreted quantitatively in terms of slow primary discharge of H_3O^+ and very rapid atom combination. In solutions in the pH range 1.5-1.8 the mechanism is influenced by the diffusion of hydronium to the surface of the electrode. There appears to be no justification for assuming that water is discharged under the conditions of these experiments, nor that the electrochemical reaction is slow.

416

Catholic U. of America. Dept. of Mechanical and Aeronautical Engineering, Washington, D. C.

ELEMENTARY MECHANICS OF TURBULENT FLUID MOTION, by M. M. Munk. Mar. 1960 [150]p. incl. refs. (AFOSR-TR-60-6) (AF 49(638)516) AD 235018; PB 149686 Unclassified

Order and system in the happenings of turbulent fluid motion was analyzed. A system of turbulence mechanics was established having many good features. It is complete in that there are enough equations in relation to the unknown involved. The independent variables form a harmonious and plausible system, which can hardly be improved without enlarging it. The equations are expressed and very simple. Two principal coefficients are shown to be often constants. They are the shear coefficient $\tau/K\rho$ and the rotation coefficient $S\ dU/dy/\nu$. They illustrate the separation of the dynamic effects and the diffusive effects taking place. Results show that the 2 principal turbulence effects have little inclination to combine to joint action. The analysis was carried far enough for establishing even the numerical information needed, although only provisional, and subject to revision and refinement. The order of magnitude of the major multipliers was definitely established.

417

Catholic U. of America. [Dept. of Physics] Washington, D. C.

MASTER EQUATION SOLUTION OF ORNSTEIN-UHLENBECK PROCESSES, by J. I. Bowen and P. H. E. Meijer. [1960] [7]p. incl. diagr. (AFOSR-TN-60-78) [AF 49(638)452] AD 295866 Unclassified

Also published in Physica, v. 26: 485-491, July 1960.

The continuous master equation is solved in closed form for transition probabilities which are Gaussian and assuming the equilibrium solution to be Gaussian (i.e., the equilibrium fluctuations are Gaussian processes). In this case, the eigenfunctions of the integral equation obtained after the kernel is symmetrized are merely Hermite functions and the eigenvalues are related to one another as successive integer powers of a const $\mu_n = \rho^n$. The constant ρ is the correlation coefficient for the (stationary) equilibrium process, over the unit time in which the transition probabilities are expressed. The complete (time-dependent) solution for the probability density function is an infinite series of Hermite-type functions, each modified by a term decaying in time. For these Ornstein-Uhlenbeck processes, the relaxation times decrease inversely proportional to the order to the term. The time dependent moments of the distribution of order n can be simply calculated from a knowledge of not more than $(n+1)/2$ moments of lower order of the initial distribution. Several examples, of different initial distributions, are given. (Contractor's abstract)

418

Catholic U. of America. Dept. of Physics, Washington, D. C.

THE SOLUTION OF THE STEADY STATE DISTRIBUTION IN NON-EQUILIBRIUM PROCESSES; ORNSTEIN-UHLENBECK PROCESSES, by P. H. E. Meijer and J. I. Bowen. [1960] [6]p. incl. diagrs. (AFOSR-TN-60-79) [AF 49(638)452] Unclassified

Also published in Rarefied Gas Dynamics; Proc. Second Internat'l. Symposium, California U., Berkeley (Aug. 3-6, 1960), New York, Academic Press, 1961, p. 277-282.

The master equation for the probability density function of a system in contact with a heat bath is solved with help of a complete set of functions, orthogonal to the Maxwell distribution. This leads to a secular determinant. Its eigenvalues are the inverse relaxation times. Two weakly coupled systems, each kept at different temperatures, are considered. The resulting set of coupled master equations can be solved by a perturbation method. Thus the steady state solution can be written as a power series in the matrix elements of the transition probability from one container to the other. The leading term gives the correct expression for the thermopressure effect. The kernel in the uncoupled equation of a form corresponding to the Ornstein-Uhlenbeck process is chosen. The secular matrix is diagonalized if Hermite functions are used as eigenfunctions. Hence, the relaxation of an arbitrary initial distribution can be calculated as is illustrated with a specific example. (Contractor's abstract)

419

Catholic U. of America. Dept. of Physics, Washington, D. C.

A GROUP THEORETICAL PROOF OF KRAMERS' THEOREM, by P. H. E. Meijer. [1959] [4]p. (AFOSR-TN-60-490) [AF 49(638)452] Unclassified

Also published in Physica, v. 26: 61-65, Jan. 1960.

The degeneracy of the energy levels of an ion in a crystalline field is at least 2-fold if the ion contains an odd number of electrons (Kramers' theorem). This theorem can be proven entirely on the basis of group theory. The odd-electron systems are shown to have representations of the second kind. From this follows not only Kramers' theorem, but also a number of implications usually attributed to time reversal. (Contractor's abstract)

420

Catholic U. of America. [Dept. of Physics] Washington, D. C.

NOTE ON THE BEHAVIOR OF A VAPOR-LIQUID SYSTEM ABOVE AND BELOW THE CRITICAL POINT, by P. H. E. Meijer. [1960] 6p. (AFOSR-TN-60-793) (AF 49(638)452) AD 288110 Unclassified

On the basis of Van der Waals' equation, it is shown that the maxima in the specific heat at constant pressure (infinite below the critical point and finite above) lie on one continuous line through the critical point. Experimental data fit the curve, above as well as below the critical point, although Van der Waals' equation is known to be not entirely correct. The calculation is based on the rules of Ehrenfest for higher order transitions and does not make use of the caloric properties of the substance. (Contractor's abstract)

421

Catholic U. of America. [Dept. of Physics] Washington, D. C.

LINE SHAPE OF ULTRAVIOLET ABSORPTION IN SOLID NOBLE GASES, by P. H. E. Meijer. [1960] [5]p. incl. diagr. refs. (AFOSR-J90) [AF 49(638)452] AD 400132 Unclassified

Also published in Jour. Chem. Phys., v. 34: 2078-2082, June 1961.

The absorption of ultraviolet radiation in solid noble gases shows lines that are a few hundred inverse centimeters broad. An attempt is made to explain and calculate the width and shape of these lines on the basis of a tentative curve of energy versus configuration. It is shown that the width has the proper order of magnitude. The line shape can be easily calculated at the short wave length end. It should show an exponential tail. Inspection of the expression for small values of the energy, a rapidly rising exponential is found, which will give rise to a smeared-out edge appearance. The line will have a nonsymmetrical shape.

422

Catholic U. of America. [Dept. of Physics] Washington, D. C.

THE SOLUTION OF THE STEADY STATE DISTRIBUTION IN NON-EQUILIBRIUM PROCESSES, by P. H. E. Meijer and J. I. Bowen. [1960] [7]p. incl. refs. [AF 49-(638)452] Unclassified

Published in Physica, v. 26: 478-484, July 1960.

The master equation, written in continuous form, is solved with a complete set of functions. The condition of detailed balancing is used to symmetrize the integral equation. The functions are chosen to be orthogonal to the equilibrium solution and the components are suggested to be useful as non-equilibrium (steady state) parameters. The general solution for the steady state of 2 thermally coupled systems is evaluated. (Contractor's abstract)

423

Central State Coll., Wilberforce, Ohio.

HIGH TEMPERATURE COMBUSTION METHOD FOR ORGANIC FLUORINE, by S. Cooper, L. Jones and others. Mar. 2, 1960 [15]p. incl. diagr. tables, refs. (AFOSR-TR-60-34) (AF 18(600)1573) AD 234427; PB 157712 Unclassified

An investigation was made in order to find a suitable method for quantitative micro-determination of F_2 in organic compounds by catalytic dry combustion in an O_2 stream subsequent reaction of the F_2 or fluoride ion with a solid "absorbent" to form a weighable compound. The apparatus and procedures used for the gravimetric determinations of F_2 as SiF_4 and MgF_2 were described. Both were unsuccessful because of the difficulty to produce a reaction between F_2 and the quartz in the case with SiF_4, the erratic results in the case with MgO as the reactant. Of the 2 solid "absorbents" used, MgO seemed to hold the most promise as a reactant for future studies. Furthermore, a semi-micro rather than micro-method might be more feasible under the conditions reported herein.

424

Chicago U. Chicago Midway Labs., Ill.

ANGULAR DISTRIBUTION OF SECONDARY ELECTRONS FROM (100) FACES OF COPPER AND NICKEL, by J. Burns. [1960] [13]p. incl. diagrs. refs. (AFOSR-3658) (AF 18(603)9) Unclassified

Published in Phys. Rev., v. 119: 102-114, July 1, 1960.

The angular distributions of secondary electrons from (001) faces of copper and nickel single crystals have been measured for secondaries in four energy ranges (0-10 ev, 10-20 ev, 20-40 ev, and 40-90 ev) for primary electron energies of 250, 500, and 800 ev. Fine structure was observed which consisted of weak peaks in the angular distribution superimposed on a background having approximately a cosine distribution. After making corrections for the refraction of secondaries at the surface of the crystal, the internal angular distribution peaks fall along principal low-index directions in the crystal as suggested in the quantum-mechanical collision theories of Wooldridge and of Dekker and van der Ziel. The positions, intensities, and widths of the peaks cannot be accounted for in terms of diffraction of the internal secondaries. The observed peaks are believed to be secondaries produced in the initial collision between the primary electron and a lattice electron of the crystal, enough of these secondaries having escaped the crystal without further collisions to make their observation possible. Details of the angular distribution are in agreement with collision theory based on a screened Coulomb interaction with a velocity-dependent screening length. The velocity dependence of the screening coefficient in the screened Coulomb interaction leads to a sharp drop in the inelastic cross section for energy transfers larger than the plasma excitation energy, and it also leads to increased probability for collisions in which the primary suffers only small deflections. The role of the band structure of the crystal in determining the features of the collision is discussed. In Cu and Ni the vacuum level of potential lies in the second Brillouin zone, so only interzone (umklapp) transitions can lead to secondary electron emission form these metals. Surface refraction is treated in terms of a velocity-dependent refractive index, and the experiment offers a means of determining the velocity dependence of the index. Experimental procedures and precautions required to observe the angular distribution fine structure are discussed. (Contractor's abstract)

425

Chicago U. Committee on Mathematical Biology, Ill.

IN SEARCH OF THE FUNDAMENTAL UNITS OF PERCEPTION: AN OUTLINE, by P. H. Greene. June 1, 1961 [30]p. (AFOSR-TN-60-622) (AF 49(638)414) AD 268009 Unclassified

Many properties of neurons and neural networks may be described mathematically. The relation of these properties to perception may be understood, however, only if one has some idea of the nature of the fundamental units of perception. Much study has been devoted to the problem of how the brain transforms incoming signals into useful form. An area of study which is comparatively undeveloped is investigation of the active role of the nervous system in the forging of significant perceptual units, and the fitting of these units to experience. The present outline is designed as an elementary introduction to ideas in this area. It is intended as an elaboration of the author's earlier paper (item no. 305, Vol. III), and as an introduction to mathematical results cited herein. (Contractor's abstract)

426

Chicago U. Committee on Mathematical Biology, Ill.

THE FORMATION OF CELL ASSEMBLIES, by H. White. [1960] [11]p. incl. diagrs. refs. (AFOSR-TN-60-623) (AF 49(638)414) AD 255437 Unclassified

Also published in Bull. Math. Biophys., v. 23: 43-53, 1961.

A simple model is presented for the formation of functional groups in a random neural net. They show the following characteristics: (1) They can maintain autonomous activity which might serve as temporary memory traces. (2) Early in the process of formation they become resistant to contraction. (3) Later they become resistant to expansion. (4) Nearby groups inhibit one another. (5) Two groups may contain some cells in common. It is pointed out that a direct attempt to relate

the phenomena discussed in this paper with psychological evidence would be misleading. If there are such things as cell assemblies, evidence relating to the "law of mass action" indicates that it is the interaction of great numbers of them that influence behavior. There are about 10^{10} neurons in the nervous system; if one in ten were incorporated into an assembly and the mean assembly size were 10^4, there would be 10^5 assemblies. (Contractor's abstract, modified)

427

Chicago U. Committee on Mathematical Biology, Ill.

A NOTE ON MATHEMATICAL MODELS FOR THE INTERACTION OF NEURAL ELEMENTS, by H. D. Landahl. [1960] [7]p. incl. diagrs. refs. (AFOSR-TN-60-664) (AF 49(638)414) AD 255436 Unclassified

Also published in Bull. Math. Biophys., v. 23: 91-97, 1961.

By introducing a plausible model for the initiation of axonal impulses the output is obtained as a function of the input incoming impulses. If the temporal aspects of the excitatory process resulting from the afferent impulses are sufficiently rapid one obtains the discontinuous or microscopic model of McCulloch-Pitts. If these are sufficiently slow a continuous model, such as Rashevsky's one or two factor theory, is a natural model. But the linear relation between the strength of excitation of one axon and excitatory factor of the next will not in general hold. However, under conditions which are not too restrictive the linear relation with threshold can be considered as satisfactory approximation over a fairly wide range of values. (Contractor's abstract)

428

Chicago U. Dept. of Mathematics, Ill.

TRIPLE TORSION PRODUCTS AND MULTIPLE KUNNETH FORMULAS, by S. Mac Lane. Nov. 1959, 24p. (AFOSR-TN-60-45) (AF 18(600)1383) AD 231091; PB 145512 Unclassified

Also published in Math. Ann., v. 140: 51-64, 1960.

The Künneth formula for the homology of a tensor product of three factors, obtained by iterating that for two factors, is not formally symmetric in the three factors. This is remedied by introducing new functors of three arguments, which are of intrinsic interest. Write H_i for the homology of a chain complex K_i of an abelian group, and H for that of $K_1 \otimes K_2 \otimes K_3$. Assuming that at least two of the K_i have no torsion, one has in H a series of subgroups with quotients naturally isomorphic to $Q_1 = \mathrm{Tor}(\mathrm{Tor}(H_1, H_2), H_3)$, $Q_2 = \mathrm{Tor}(H_1 \otimes H_2, H_3)$, $Q_3 = \mathrm{Tor}(H_1, H_2) \otimes H_3$, and $Q_4 = H_1 \otimes H_2 \otimes H_3$; this decomposition splits, but the isomorphism of H to the direct sum of the quotients is not natural. Although Q_1 is known to be symmetric in the H_i, it is not symmetrically defined by generators and relations in a symmetric manner. Now Q_1 is naturally isomorphic to $\mathrm{Tor}(H_1, H_2, H_3)$. A second functor $\mathrm{Trip}(A_1, A_2, A_3)$ is defined symmetrically by imposing on the direct sum T of the three cyclic permutations of $\mathrm{Tor}(A_1, A_2) \otimes A_3$ a "Jacobi identity". The new triple Künneth formula now asserts that H has a chain of subgroups with quotients naturally isomorphic to $\mathrm{Tor}(H_1, H_2, H_3)$, $\mathrm{Trip}(H_1, H_2, H_3)$, and $H_1 \otimes H_2 \otimes H_3$. As expected, $\mathrm{Trip}(A_1, A_2, A_3)$ has a chain with quotients $\mathrm{Tor}(A_1 \otimes A_2, A_3)$ and $\mathrm{Tor}(A_1, A_2) \otimes A_3$, and this decomposition splits. But, it is shown, $\mathrm{Trip}(A_1, A_2, A_3)$ is not isomorphic to the direct sum of the two quotients under any natural isomorphism. It is noted that Trip can be described as the quotient of the functor T mentioned above by a functor S with a definition reminiscent of that of $\mathrm{Tor}(A_1, A_2, A_3)$. The question of whether Trip is a composite of functors of two variables is left open, as is that of what happens for more than three factors, or for modules over rings other than the integers. (Math. Rev. abstract)

429

Chicago U. Dept. of Mathematics, Ill.

THE COHOMOLOGY THEORY OF A PAIR OF GROUPS, by F. Halme and S. Mac Lane. Apr. 1960, 24p. incl. refs. (AFOSR-TN-60-115) (In cooperation with Washington U. Dept. of Mathematics, St. Louis, Mo.) (AF 18(600)1383)and AF 49(638)218) AD 235987; PB 146781 Unclassified

Also published in Illinois Jour. Math., v. 5: 45-60, Mar. 1961.

For abstract see Item no. 2866, Vol. IV.

430

Chicago U. Dept. of Mathematics, Ill.

ON UNSTABLE HOMOTOPY OF SPHERES AND CLASSICAL GROUPS, by H. Toda. [1960] 6p. (AFOSR-TN-60-672) (AF 18(600)1383) Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 46: 1102-1105, Aug. 1960.

The following theorem concerning the unstable homotopy groups of spheres and classical groups is proven. Theorem 1: Let p be an odd prime. Let $m = k(p-1) + 1$ for some integers $k \geq 1$ and $p > 1 \geq 1$. Then the p-primary component of $\pi_{2m}(SU(j))$ is not zero for $m \geq j > 1$. Corollary: Let $n = k(p - 1)/2 + 1$ for $k \geq 1$ and $(p - 1)/2 > 1 \geq 0$. Then the p-primary component of $\pi_{4n+2}(SO(j'))$ is not zero for $n \geq j > 1$. The p-primary component of $\pi_{4n+2}(SO(j'))$ is not zero for $4n + 2 \geq j' \geq 41 + 4$. Theorem 2: Let p be an odd prime and let $k \geq 1$ and $i \geq 3$. Then the p-primary component of $\pi_{2k(p-1)-1+1}(S^i)$ is not zero. In this proof an element $\alpha_k(1) \in \pi_{n+1}(S^i)$, $n = 2k(p - 1)-1$, $i \geq 3$, of order p is exhibited and proven to be not decomposable. (Math. Rev. abstract, modified)

431

Chicago U. Dept. of Mathematics, Ill.

NOTE ON COHOMOLOGY ALGEBRAS OF SYMMETRIC GROUPS, by M. Nakaoka. June 1960, 18p. (AFOSR-TN-60-757) (AF 18(600)1383) PB 150059 Unclassified

This paper deals with the mod p cohomology algebra $H^*(S(m); Z_p)$ of the symmetric group S(m) of degree m, where $1 < m \leq \infty$ and p is a prime. The diagonal homomorphism $d_* : H_*(S(m); Z_p \to H_*(S(m); Z_p) \times H_*(S(m); Z_p)$ is described in terms of the basis. Some results on the cohomology algebra $H_*(S(m); Z_p)$ are derived by its conversion.

432

Chicago U. Dept. of Mathematics, Ill.

HOW TO GAMBLE IF YOU MUST; INEQUALITIES FOR STOCHASTIC PROCESSES, by L. E. Dubins and L. J. Savage. Nov. 25, 1960. New York, McGraw-Hill Book Co., 1965, 245p. incl. diagrs. table, refs. (AFOSR-TN-60-1257) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)391, Ford Foundation, John Simon Guggenheim Memorial Foundation, Michigan Inst. of Science and Technology, National Science Foundation, and Office of Naval Research) AD 246859 Unclassified

The hypothetical question of how to convert $1,000 into $10,000 by gambling is used to introduce a series of mathematical probabilities on stochastic processes. Various types of gambling games are used, such as red- and black-casinos, to illustrate the mathematical problem involved. The ingenious approach to the study is meant as a means of introducing the subject matter, and not a device that should motivate the reader to venture too far from his arm chair in order to verify the information with a practical application.

433

Chicago U. [Dept. of Mathematics] Ill.

SMOOTHNESS AND DIFFERENTIABILITY OF FUNCTIONS, by E. M. Stein and A. Zygmund. [1960] [13]p. (AFOSR-3328) (AF 49(638)451) Unclassified

Also published in Ann. Univ. Scient. Budapestinensia de Rolando Eötvös Nominatae, Sect. Math., v. 3-4: 295-307, 1960/61.

Let F be a real-valued function on a real interval I, and let E be a subset of I. Suppose that at each point x of E the second difference $\Delta^2 F(x, h) = F(x + h) + F(x - h) - 2F(x)$ satisfies the condition $\Delta^2 F(x, h) = 0\{h\psi(h)\}$ as $h \to 0+$, where $\psi(h)$ is defined for all h in a right neighborhood of $h = 0$, decreases monotonically to 0 with h, and has $\psi^2(h)/h$ integrable near $h = 0$. Under these conditions it is shown, as a consequence of some nine lemmas, that F must be differentiable a.e. in E. It is also shown that this result continues to hold if the second difference $\Delta^2 F(x, h)$ is replaced by any given higher-order symmetric difference $\Delta^k F(x, h)$. (Math. Rev. abstract)

434

Chicago U. [Dept. of Mathematics] Ill.

LOCAL PROPERTIES OF SOLUTIONS OF ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS, by A. P. Calderón and A. Zygmund. [1960] [55]p. incl. refs. (AFOSR-3329) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)451 and National Science Foundation under NSF G-8205) Unclassified

Also published in Studia Math., v. 20: 171-225, 1961.

The purpose of this paper is to establish pointwise estimates for solutions of elliptic partial differential equations and systems. Inequalities for solutions and their derivatives at isolated individual points are obtained. Also considered are almost everywhere type results. The following two theorems summarize the main results. (1) Let $Tf = g$ be an equation of order m with coefficients in $T_u(x_o)$, $u > 0$, which is elliptic at x_o. Let $1 < p < \infty$, $u \geq v \geq -n/p$ and v be non-integral. If $f \in L^p_m$ and $g \in T^p_v(x_o)$ in the sense that their components belong to these spaces, then

$$T^q_{v+m-|\alpha|}\left(x_o, \left(\frac{\partial}{\partial x}\right)^\alpha f\right) \leq C\left[\sum_{i=1}^{s} T^p_v(x_o, g_i) + \sum_{i=1}^{r} \|f_i\|_{p,m}\right],$$

where $1/p \geq 1/q \geq 1/p - (m - |\alpha|)/n$ if

$1/p - (m - |\alpha|)/n > 0$, $p \le q < \infty$ if $1/p < (m - |\alpha|)n$, or $p \le q < \infty$ if $1/p = (m - |\alpha|)/n$, and C depends only on v, p, r, s, $u(x_0)$ and the least upper bound of the norms in $T_u(x_0)$ of the coefficients of $\mathfrak{L}$. (2) Let $\mathfrak{L} f = g$ be an equation of order m which is elliptic at all points x_0 belonging to a set Q of positive measure, and whoce coefficients belong to $T_u(x_0)$, $u \le 1$, for all x_0 in Q. Let v be a positive integer not larger than u. Then, if $g \in T_v^p(x_0)$, $1 < p < \infty$, for all x_0 in Q, and $f \in L_m^p$, the functions $(\partial/\partial x)^a f$, $|\alpha| < m$, belong to $t_{v+m-|\alpha|}^q(x_0)$ for almost all x_0 in Q, where q is the same as in Theorem 1.

435

Chicago U. Dept. of Mathematics, Ill.

A NOTE ON LOCAL PROPERTIES OF SOLUTIONS OF ELLIPTIC DIFFERENTIAL EQUATIONS, by A. P. Calderón and A. Zygmund. [1960] [5]p. (AFOSR-3330) (AF 49(638)451) AD 613787 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 46: 1385-1389, Oct. 1960.

The pertinent notion of differentiability involves estimation of the remainder in Taylor's formula in the mean with various exponents. A function f belongs to the class $T_u^p(x_0)$, $1 \le p \le \infty$, $u \ge -n/p$, if $f \in L^p$ and there exists a polynomial P of degree $< u$ such that (1) $\left\{\rho^{-n}\int_{|x-x_0|\le\rho} |f(x) - P(x-x_0)|^p dx\right\}^{1/p} \le A\rho^u (0 < \rho < \infty)$. A function f belongs to $t_u^p(x_0)$ if $f \in T_u^p(x_0)$ and there is a polynomial P of degree $\le u$ such that the left side of (1) is $o(\rho^u)$ as $\rho \to 0$. Any $f \in L^p$ belongs to $T_u^p(x_0)$ for $u = -n/p$ and any x_0, and the familiar result on the Lebesque set of a function can be expressed by saying that if $f \in L^p$, $p < \infty$, then $f \in t_0^p(x_0)$ for almost all (x_0). A special case is if $f \in T_u^p(x_0)$, $1 < p \le \infty$, u a positive integer, on a set of positive measure, then $f \in T_u^p(x_0)$ almost everywhere in this set. The case $u = 1$ and $p = \infty$ is the Rademacher-Stepanov theorem. The main theorem on elliptic partial differential equations and systems are basically of the following kind. Let $Lf = g$ be an elliptic equation of order m. If $g \in T_u^p(x_0)$, then $f \in T_{u+m}^q(X_0)$; if $g \in T_u^p(x_0)$, then $f \in t_{u+m}^q(x_0)$. Here u is a non-integral, $1 < p < \infty$, and q depends on p, m, and n. (Math. Rev. abstract)

436

Chicago U. [Dept. of Mathematics, Ill.]

THE INTEGRATED FORM OF THE FIRST MAIN THEOREM FOR COMPLEX ANALYTIC MAPPINGS IN SEVERAL COMPLEX VARIABLES, by S.-S. Chern. [1959] [16]p. (AF 49(638)525) Unclassified

Published in Ann. Math., v. 71: 536-551, May 1960.

Let f be a complex analytic mapping of the m-dimensional complex space E_m into the m-dimensional complex projective space P_m; let A be a point of P_m, and D be a compact domain in E_m. The first main theorem for such mappings states that if $f^{-1}(A) \cap D$ consists of $n(D, A) < \infty$ points, counting multiplicities appropriately, and if $f^{-1}(A) \cap \partial D = \varphi$, where ∂D is the boundary of D, then (1) $n(D, A) = v(D) + \int_{f(\partial D)} \Lambda$, where v(D) is the volume of $f(D) \subset P_m$ and Λ is a differential form in P_m which depends only upon the point A. In the present paper the case is considered in which $D = D_r$ is a sphere of radius r centered at the origin in E_m. The final theorem takes on a simpler form when it is used to determine the integral $N(r, A) = \int_{r_0}^{r} t^{1-2m} n(D_t, A)\, dt$, rather than the number $n(D_r, A)$ itself; this is the integrated form of the first main theorem. This form leads to an asymptotic estimate of the form $N(r, A) < T(r) + S(r, A) +$ (constant), where $T(r) = \int_{r_0}^{r} t^{1-2m} v_0(t) dt$ and $v_0(t)$ is the volume of $f(D_t)$ in P_m in terms of the standard metric on P_m; T(r) is a generalization of the Nevanlinna order function in one complex variable, while S(r, A) is a new and rather more complicated term necessary in the case of several variables. As an application of this result, a most interesting criterion is obtained for the complement $P_m - f(E_m)$ to be a set of measure zero.

437

Chicago U. Dept. of Mathematics, Ill.

QUASI-FINITENESS OF THE INTERACTION HAMILTONIAN OF CERTAIN QUANTUM FIELDS, by I. E. Segal. Apr. 1960, 15p. (Technical rept. no. 1) (AFOSR-TN-60-445) (AF 49(638)668) AD 236512; PB 147119 Unclassified

Also published in Ann. Math., v. 72: 594-602, Nov. 1960.

Let $A_1, A_2, \ldots B_1, B_2, \ldots$ be 2 sequences of self-adjoint operators in a Hilbert space K, all of which commute. The main result is that there exists a Hilbert space L and sequences $Q_1, Q_2, \ldots$ and $P_1, P_2, \ldots$

of self-adjoint operators on the product K x L = M of these Hilbert spaces such that

$$\Sigma n((A_n \times I)P_n+(B_n \times I)Q_n)$$

has a closure which is essentially self-adjoint. Sums of the indicated form occur in quantum field theory but do not yield well defined operators when the standard solution of the Heisenberg's commutation relations is used as the set of P's and Q's. Thus certain divergences can be eliminated by simply changing from one solution of the Heisenberg commutation relations to another. This fact is submitted as evidence that the divergences are of analytical rather than physical origin and suggests that one seeks to define the Hamiltonian in terms of automorphisms of the algebra of bounded observables rather than directly as a self-adjoint operator. (Math. Rev. abstract)

438

Chicago U. Dept. of Mathematics, Ill.

QUANTIZATION OF NON-LINEAR SYSTEMS, by I. E. Segal. May 1960, 70p. incl. refs. (Technical note no. 2) (AFOSR-TN-60-575) (In cooperation with Copenhagen U. (Denmark)) (AF 49(638)666) AD 238336; PB 148416 Unclassified

Also published in Jour. Math. Phys., v. 1: 468-488, Nov.-Dec. 1960.

A direct method of quantization, applicable to a given non-linear hyperbolic partial differential equation, is indicated. From such classical equations alone, without a given Lagrangian or Hamiltonian, or a priori linear reference system such as a bare or incoming field, a quantized field is constructed, satisfying the conventional commutation relations. While mathematically quite heuristic in part, local products of quantized fields do not intervene, and there are grounds for the belief that the formulation is free from non-trivial divergences. (Contractor's abstract)

439

Chicago U. [Dept. of Mathematics] Ill.

SEMI-SIMILARITY INVARIANTS FOR SPECTRAL OPERATORS ON HILBERT SPACE, by A. N. Feldzamen. [1960] [48]p. incl. refs. [Technical note no. 1] (AFOSR-TN-60-506) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)693 and National Science Foundation) AD 237731; PB 148091 Unclassified

Also published in Trans. Amer. Math. Soc., v. 100: 277-324, Aug. 1961.

This paper contains proofs and some extensions of results previously announced by the author (Bull. Amer. Math. Soc., v. 65: 79-83, 1959). For a class of bounded spectral operators on (not necessarily separable) Hilbert space, namely, those operators whose resolution of the identity contains no projection of infinite uniform multiplicity, a complete set of invariants is found for a natural equivalence relation which preserves spectrum, called semi-similarity. Two spectral operators S, T are called semi-similar if there exist families of disjoint subspaces H_α, K_α which are spectral subspaces for S and T, respectively, each family separately spanning Hilbert space, and bounded operators A_α from H_α to K_α with bounded inverses, such that $A_\alpha^{-1}TA_\alpha x = Sx$ for all x in H. The invariants obtained are a natural generalization of the classical Weyr characteristic for matrices, much as the multiplicity function generalizes the notion of multiplicity of an eigenvalue for a normal matrix. The investigation is carried out through the multiplicity theory for a normal operator similar to the scalar part of the spectral operator. Semi-similar scalar operators are actually similar; an example of a direct sum of 2 x 2 matrices shows that infiniteness of the spectrum precludes any hope of replacing semi-similarity in generaly by ordinary similarity. The Weyr characteristics of an operator and its adjoint are shown to be the same. Proofs are generally straight-forward once the necessarily complex notation is transcended. (Math. Rev. abstract, modified)

440

Chicago U. [Dept. of Psychology] Ill.

DISCRIMINATION AFTER AUDITORY CORTEX ABLATION (Abstract), by J. M. Goldberg and W. D. Neff. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)99] and Office of Naval Research) Unclassified

Presented at Sixtieth meeting of the Acoust. Soc. Amer., San Francisco, Calif., Oct. 20-22, 1960.

Published in Jour. Acoust. Soc. Amer., v. 32: 1494, Nov. 1960.

A neural model is proposed to describe the activity of subcortical auditory centers in the cat after auditory cortex removal. In the model it is assumed that, at any level of the auditory system, tones of different frequencies excite, at least in part, different neurons; and the higher the sound intensity of a tone, the more neurons it excites. It is also assumed that there is a decrement in response (habituation) to repeated stimulation such that the neural response to a tone shows a decrease in size when the tone is repeated once every few sec for about a min, but not for intervals much shorter than a min. The habituation process is confined to those neurons stimulated by the tone. The events which take place during different discriminatory tasks can be reconstructed by means of the model. It is found that relearned auditory discriminations have the property of responding to negative and positive stimul that differ in size. Discriminations severely impaired by such a lesion do not possess this property.

441

Chicago U. [Dept. of Psychology] Ill.

NEURAL MECHANISMS OF AUDITORY DISCRIMINATION, by W. D. Neff. [1959] [20]p. incl. diagrs. refs. (AFOSR-1290) (Sponsored jointly by Air Force Cambridge Research Center, Air Force Office of Scientific Research under [AF 49(638)925], Office of Naval Research, Sonics Research Foundation, and the Wallace C. and Clara A. Abbot Memorial Fund) Unclassified

Published in Sensory Communication; Contributions to the Symposium on Principles of Sensory Communication, Endicott House, M.I.T. (July 19-Aug. 1, 1959) [Cambridge] M.I.T. Press, 1961, p. 259-278. (AFOSR-796)

The results obtained in studies of localization of sound in space and of discriminations of changes in frequency, pattern, and duration to tones are summarized. A comparison of the findings for the cat and the monkey is given, and related clinical studies on man are noted. Finally, an attempt is made to construct a simple, neural model that will explain the differences between discriminations that can and cannot be made after ablation of auditory areas of the cerebral cortex. (Contractor's abstract, modified)

442

Chicago U. Dept. of Psychology, Ill.

HIGHER AUDITORY CENTERS AND THE DL FOR SOUND INTENSITIES (Abstract), by R. E. Oesterreich and W. D. Neff. [1960] [1]p. (AFOSR-1719) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)925 and Office of Naval Research) Unclassified

Presented at Forty-fourth annual meeting of the Fed. Amer. Soc. for Exper. Biology, Chicago, Ill., Apr. 11-15, 1960.

Also published in Fed. Proc., v. 19: 301, Mar. 1960.

Cats were trained by the shock avoidance technique to respond to a change in intensity of a tone. Difference limens (DLs) were determined before and after bilateral cortical ablations ranging in size from auditory areas I, II, and Ep to I, II, Ep, somatic area II, anterior suprasylvian gyrus, and insular-temporal region. DLs were unchanged after ablations of either cortex or inferior colliculus. A combined cortical and inferior colliculus ablation resulted in a small change in the DL for intensity. Threshold shifts after section of the brachium of the inferior colliculus varied from 0 to 10 db depending on the extent of the lesion. The results of this study suggest that intensity discriminations may be mediated by auditory centers at tectal or medullar levels. (Contractor's abstract, modified)

443

Chicago U. [Dept. of Psychology] Ill.

HIGHER FUNCTIONS OF THE CENTRAL NERVOUS SYSTEM, by W. D. Neff and J. M. Goldberg. [1960] [26]p. incl. refs. (AFOSR-1720) (AF 49(638)925) Unclassified

Also published in Ann. Rev. Physiol., v. 22: 499-524, 1960.

Recent trends in physiological psychology are considered from an experimental point of view. Principal topics covered are: ablation studies bearing on the projection and association areas of the cortex, on the limbic system, and on subcortical centers and pathways; electrical recording and stimulation related to learning, sensory discrimination, sleep and consciousness, and emotion and motivation; and brain biochemistry and behavior. Work in these areas by various researchers within the recent past is reviewed and commented on.

444

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

TRAPPED AND COSMIC RADIATION MEASUREMENTS FROM EXPLORER VI, by C. Y. Fan, P. Meyer, and J. A. Simpson. Dec. 1959 [26]p. incl. diagrs. (Rept. no. EFINS-59-73) (AFOSR-TN-60-350) (Sponsored jointly by Air Force Office of Scientific Research under AF 18-(600)666 and National Aeronautics and Space Administration) AD 249811 Unclassified

The earth satellite Explorer VI was placed in an elliptic orbit which passed through both the regions of geomagnetically trapped radiation, and untrapped regions at greater distances from the earth. An instrument which measures protons ≥ 75 mev (or electrons ≥ 13 mev) separately from, and in the presence of, bremsstrahlung producing trapped electrons was used to investigate three problems: (1) The structure of the VanAllen radiation regions, and changes of structure with time, (2) The detection of solar flare high energy particles, and (3) The electromagnetic phenomenon of solar origin which leads to modulation of cosmic ray intensity. This paper is a preliminary report of these studies. (Contractor's abstract)

445

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

EXPERIMENTS ON THE ELEVEN YEAR CHANGES OF COSMIC RAY INTENSITY USING A SPACE PROBE, by C. Y. Fan, P. Meyer, and J. A. Simpson. Aug. 1960 [10]p. incl. diagrs. (Rept. no. EFINS-60-43) (AFOSR-TN-60-998) (Sponsored jointly by Air Force Cambridge Research Center under AF 19(604)4554; Air Force Office of Scientific Research under AF 18(600)666, and National Aeronautics and Space Administration under NASw-135) AD 247967 Unclassified

Also published in Phys. Rev. Ltrs., v. 5: 272-274, Sept. 15, 1960.

Experiments were performed which prove that any mechanism changing the cosmic-ray intensity over 11 yr is centered about the sun, and the scale size is > 1 astronomical unit for the volume of space in which the cosmic-ray intensity is reduced at this period of the solar activity cycle. It is also found that the gradient of cosmic-ray intensity near the orbit of the Earth is so small as to suggest that modulation of galactic intensity occurs at distances much greater than the orbit of Earth. The experiments were carried out by using cosmic radiation detectors measuring protons above 75 mev and lifted into interplanetary space by satellite Explorer VI (launched Aug. 7, 1959) and the space probe Pioneer V (launched Mar. 11, 1960). Between these dates the integrated cosmic-ray intensity at the Earth increased by 13%. The results point to the conclusion that there must be a cosmic-ray gradient somewhere between interstellar space and the inner solar system.

446

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

THE RAPID REDUCTION OF COSMIC RADIATION INTENSITY MEASURED IN INTERPLANETARY SPACE, by C. Y. Fan, P. Meyer, and J. A. Simpson. Aug. 1960 [11]p. incl. diagrs. (Rept. no. EFINS-60-42) (AFOSR-TN-60-999) (Sponsored jointly by Air Force Cambridge Research Center under AF 19(604)4554, Air Force Office of Scientific Research under AF 18(600)666, and National Aeronautics and Space Administration under NASw-135) AD 247969 Unclassified

Also published in Phys. Rev. Ltrs., v. 5: 269-271, Sept. 15, 1960.

Experiments conducted at a distance of 8×10^6 km from the earth show that the mechanism responsible for the rapid decreases of galactic cosmic-ray intensity are not associated with the earth or its magnetic field. Strong evidence is also found that there is a bulk motion outward from the sun of conducting solar plasma ejected in association with a solar flare which either carries magnetic fields within itself, or manipulates an interplanetary magnetic field to remove convectively the galactic cosmic radiation from a limited volume of the inner solar system. The experimental apparatus was carried in the space probe Pioneer V launched Mar. 11, 1960 on a trajectory inside the orbit of the earth and towards the orbit of Venus. It is concluded that the decrease of cosmic-ray intensity, measured as high as 5%, applies to the removal rate of particles and, hence, to the transient magnetic field parameters in the interplanetary medium. It is also believed that Pioneer V provides the most direct evidence to date for the existence of conducting gas ejected at high velocity from solar flares.

447

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

THE COSMIC RAY ALPHA PARTICLE FLUX DURING SHARP FORBUSH INTENSITY DECREASES, by P. Meyer. Aug. 1960 [22]p. incl. diagrs. tables. (AFOSR-TN-60-1159) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)666 and National Science Foundation) Unclassified

Also published in Jour. Geophys. Research, v. 65: 3881-3887, Dec. 1960.

During three large Forbush-type intensity decreases which occurred on May 12, July 15 and July 18, 1959 the primary cosmic ray α-particle flux was measured at balloon altitudes. A comparison with the α-particle flux in an undisturbed period on Sept. 28, 1959 and with the total cosmic ray intensity as observed by neutron monitor stations shows a close correlation between the α-particle flux and the total cosmic ray flux during Forbush decreases. This evidence clearly establishes the fact that the proton and α-particle components are modulated by a common mechanism during the sharp intensity decreases. The measurement of May 16, 1959 exhibits an increase in the α-particle flux by 30% within approximately 9 hr which is not accompanied by a comparable variation in the proton flux. Similar independent changes in the α-particle flux have been noted earlier to follow Forbush decreases. During quiet days the primary α-particle flux with energies exceeding 560 mev/nucleon was about 20% higher in 1959 than in 1958. This change in intensity is probably related to the beginning decline in average solar activity. (Contractor's abstract)

448

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

THE PRODUCTION OF TRITONS AND C^{14} IN THE TERRESTRIAL ATMOSPHERE BY SOLAR PROTONS, by J. A. Simpson. [1960] [2]p. incl. refs. (AFOSR-TN-60-1432) [AF 18(600)666] Unclassified

Also published in Jour. Geophys. Research, v. 65: 1615-1616, May 1960.

A source of tritons other than accretion of solar-produced tritons by the earth and additional production by the low-energy component of the cosmic radiation at times of minimum solar activity is pointed out. This source is the intense fluxes of energetic solar protons which could produce tritons and C^{14} in the terrestrial atmosphere at times near the maximum of the solar activity cycle. A solar flare of importance 3 to 3+ in a typical event is followed within 1 to 5 hr by the arrival at earth of a large solar proton flux that continues for more than 50 hr to bombard the entire atmosphere over the polar caps and down to latitudes of approximately 65°. The contribution of these solar protons to triton

production is estimated within one solar cycle from the following facts: (1) An average cosmic-ray proton will have an energy of approximately 4 bev and lose this energy in the atmosphere by producing mesons, electrons, and electromagnetic radiation, and the nucleonic component. It is assumed that tritons and C^{14} are products of the nucleonic component. R_1 is estimated to be 5×10^{-2}. (2) The fraction R_2 of the time that solar protons irradiate the polar regions during the 11-yr solar activity cycle is $R_2 \approx 1.4 \times 10^{-2}$. (3) The fraction R_3 of the terrestrial atmosphere accessible to solar protons compared with the 4-bev cosmic-ray proton flux is $R_3 \geq 0.1$. (4) The ratio of the solar proton flux to averaged 4 bev cosmic-ray proton flux is $R_4 \approx 5 \times 10^{4}$. The R (ratio) of triton production by cosmic radiation is $R = R_1R_2R_3R_4 \approx 3.5$. This might account for the excess triton production.

449

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

ATOMIC PHOTOELECTRIC EFFECT AT HIGH ENERGIES, by R. H. Pratt. [1960] [12]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)666] and Atomic Energy Commission) Unclassified

Published in Phys. Rev., v. 117: 1017-1028, Feb. 15, 1960.

Total cross sections are obtained for the photoelectric effect from the K shell of an atom of arbitrary charge, in the limit of high energies. An approximate analytic formula then is deduced to cover the entire high-energy region. For heavy elements and very high energies the differences from previous predictions are large. It is noted that these results also apply to other processes, including the one photon annihilation of fast positrons. (Contractor's abstract)

450

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

COSMIC RADIATION INTENSITY DECREASES OBSERVED AT THE EARTH AND IN THE NEARBY PLANETARY MEDIUM, by C. Y. Fan, P. Meyer, and J. A. Simpson. [1960] [3]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)-666] and National Aeronautics and Space Administration) AD 249814 Unclassified

Published in Phys. Rev. Ltrs., v. 4: 421-423, Apr. 15, 1960.

This note reports preliminary experiments which prove that existing theory for the modulation mechanism responsible for rapid decreases of primary cosmic-ray intensity cannot invoke the presence of the earth or its magnetic field. A direct experiment was performed using a cosmic-ray detector carried by the Explorer VI satellite launched Aug. 7, 1959 to help determine: (1) How far into the interplanetary medium is the full decrease of galactic cosmic-ray intensity observed during a Forbush decrease; (2) Is the pre-existant radiation intensity found at distances beyond which the geomagnetic field could be invoked to account for the Forbush decrease, or is the intensity also reduced in the nearby interplanetary medium as it is at the earth? The results indicate that the hypothesis which invoke the presence of the earth and the geomagnetic field to account for the Forbush decreases of cosmic-ray intensity must be excluded.

451

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

VARIATIONS OF SOLAR ORIGIN IN THE PRIMARY COSMIC RADIATION, by J. A. Simpson. [1960] [29]p. incl. illus. diagrs. refs. [AF 18(600)666] Unclassified

Presented at Symposium on Astronomical Aspects of Cosmic Rays, Rochester U., N. Y., Apr. 1, 1959.

Published in Astrophys. Jour. Suppl., v. 4: 378-405, June 1960.

Characteristic types of experiments and studies related to temporary acceleration of particles to cosmic-ray energies following solar flares and the modulation of galactic cosmic-rays by electromagnetic fields of origin are presented. The evidence for acceleration of particles in the solar system and galaxy is reviewed in the light of recent experimental studies of high-energy solar-flare particles. Also reviewed are experiments and observations of changes in intensity, composition, and spectrum of the galactic cosmic radiation at low energies which provide the evidence for electromagnetic fields in interplanetary space of solar origin.

452

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

PRELIMINARY RESULTS FROM THE SPACE PROBE PIONEER V, by C. Y. Fan, P. Meyer, and J. A. Simpson. [1960] [2]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)-666] and National Aeronautics and Space Administration) Unclassified

Presented at meeting of the Amer. Geophys. Union, Washington, D. C., Apr. 30, 1960.

Published in Jour. Geophys. Research, v. 65: 1862-1863, June 1960.

The space probe Pioneer V (launched Mar. 11, 1960) measured fluxes of protons with energies greater than 75 mev, electrons with energies greater than 15 mev, and the bremsstrahlung from electrons and γ rays of lower energy. It was launched into an orbit around the sun and inside the orbit of the earth. On Mar. 20, 1960, solar activity rapidly increased with many solar flares, radio noise bursts, etc., over a period of 10 days. On Mar. 31, 1960, at a distance of 5×10^6 km from the earth, galactic cosmic-ray intensity suddenly decreased occurring at the earth and at Pioneer V. Hence, existing theoreies for this phenomenon requiring the presence of the earth and its magnetic field are proved to be invalid. The direct detection of particles accelerated in solar flares was observed in Pioneer V. On Apr. 1, 1960, not only protons, but electrons and/or γ rays from the sun were found. Reportedly at the polar cap, radio noise was absorbed in coincidence with the increase of particle flux which shows that the solar flare particles producing the ionization in the polar atmosphere for many hr are not stored in the geomagnetic field. Evidence was also found for the solar production of energetic electrons by processes other than solar flares.

453

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

DESIGN OF A GAMMA-RAY SPECTROMETER USING THE PHOSWITCH TECHNIQUE FOR REJECTION OF CHARGED PARTICLES, by F. C. Jones. [1960] [3]p. incl. diagrs. (AF 18(600)666) Unclassified

Presented at Seventh Scintillation Counter Symposium, Washington, D. C., Feb. 25-26, 1960.

Published in I.R.E. Trans. on Nuclear Sci., v. NS-7: 175-177, June-Sept. 1960.

One of the first problems encountered in the detection and measurement of the energy distribution of charged cosmic-ray particles of both primary and secondary origin which needed to be kept out of the measurement. By using a phoswitch it is possible to construct a compact detector using only one photomultiplier that combines the functions of a gamma-ray spectrometer and a charged particle guard counter. The basic technique consists of a photomultiplier simultaneously viewing a fast and a slow phosphor. When an ionizing event takes place in one or both of the phosphors, the shape of the pulse out of the photomultiplier will depend on what fraction of the ionizing energy was deposited on each phosphor. Observation of the output pulse shape can then give added information about the ionizing event. Preliminary measurements using cosmic-ray μ-mesons give an efficiency of 98.9% ± 0.2% for rejection of charged particles, and using P^{32} beta rays an efficiency of 99.3% ± 0.1% was obtained.

454

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

EFFECT OF HYDROMAGNETIC WAVES IN A DIPOLE FIELD ON THE LONGITUDINAL INVARIANT, by E. N. Parker. [1960] [16]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)666 and National Aeronautics and Space Administration) AD 257005 Unclassified

Also published in Jour. Geophys. Research, v. 66: 693-708, Mar. 1961.

Hydromagnetic wave violation of the longitudinal invariant of a particle trapped in a mirror magnetic field is investigated quantitatively. It is shown that the passage of hydromagnetic waves across the region of mirroring leads to a diffusion of the individual-particle mirror points. If the relative wave amplitude $\Delta B/B$ is maintained throughout the mirror field, particles released in the field will soon diffuse out through the mirror and be lost. Application to thermonuclear devices is obvious. Confining our attention principally to the charged particles trapped in the geomagnetic field, it is shown that high-energy (100,000-ev) electrons in the outer Van Allen radiation zone are caused to diffuse along the lines of force with a characteristic time of 4 mo by hydromagnetic waves of 1 cps and an amplitude of 10^{-4} gauss. Hydromagnetic diffusion appears to be more important than collisions in determining the electron lifetime and distribution in the outer Van Allen radiation zone. It is shown that, if the hydromagnetic disturbances extend throughout the geomagnetic field, rather than yielding particle acceleration, they result in a net loss of particle energy. (Contractor's abstract)

455

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

MESIC DECAYS OF HYPERNUCLEI FROM K^--CAPTURE. II. BRANCHING RATIOS IN THE CHARGED MESIC DECAY MODES OF $_\Lambda H^3$, $_\Lambda H^4$, $_\Lambda He^4$, AND $_\Lambda He^{5(+)}$, by R. G. Ammar, S. Limentani and others. [1960] [16]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1211) (In cooperation with Northwestern U., Evanston, Ill.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)209, Atomic Energy Commission, and National Science Foundation) AD 255783 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., May 1-3, 1958.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 3: 175, May 1, 1958.

Also published in Nuovo Cimento, Series X, v. 19: 20-35, Jan. 1, 1961.

Branching ratios in the charged mesic decay modes of hyperfragments with charge $Z \leq 2$ and mass number $A \leq 5$ are presented here, based on a total of 162 events. Such relative frequencies are relevant in discussing the consequences of charge independence, the $\Delta T = 1/2$ rule as applied to hypernuclei, and the spin dependence of the Λ-nucleon interaction. In particular, the ratio R_4 of (π-recoil) with respect to all π-decays for ${}_{\Lambda}H^4$ was found to be $R_4 = 0.67 \begin{smallmatrix} + 0.006 \\ - 0.05 \end{smallmatrix}$, where the errors represent statistical uncertainties only. Comparing this with the curves of R_4 vs (p/s) on the 2 assumptions (J = 0, 1) regarding the spin of ${}_{\Lambda}H^4$, it is concluded that the value J = 0 is more probable. If this spin assignment is accepted, it may be inferred that the ratio of p- to s-wave amplitude in the charged decay of the free Λ, $0.45 \leq p/s \leq 1.4$. Finally, although they should have the same general configuration as the π-events, no examples of decays involving either the emission of a π^+ or a charged lepton have been identified in the present sample. (Contractor's abstract, modified)

456

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

SEARCH FOR Σ^- HYPERFRAGMENTS, by R. G. Ammar, N. Crayton and others. [1960] [3]p. incl. diagrs. tables, (AFOSR-TN-60-1212) [AF 49(638)209] AD 255600
Unclassified

Published in Phys. Rev., v. 120: 1914-1916, Dec. 1, 1960.

A systematic search was undertaken for possible Σ^- compounds produced by K^- captures in nuclear emulsion. Mass determinations were performed on (a) 15 decays in flight into a charged pion and (b) 84 events resulting in capture configurations; the number of these events produced in single-nucleon K^- captures is estimated to be >32 but <71. All events of type (a) and all but 4 of type (b) are consistent with the interpretation as Σ^-. The 4 events are discussed in detail and it is concluded that, although the Σ^-n interpretation cannot be ruled out for 3 of them, in no case is the identification unequivocal. (Contractor's abstract)

457

Chicago U. [Enrico Fermi Inst. for Nuclear Studies] Ill.

BRANCHING RATIOS IN THE MESIC DECAY MODES OF ${}_{\Lambda}H^3$ AND ${}_{\Lambda}H^4$ (Abstract), by R. G. Ammar, R. Levi-Setti and others. [1960] [1]p. [AF 49(638)209]
Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 11, Jan. 27, 1960.

The relative frequencies, R_3 and R_4, for the decay modes ${}_{\Lambda}H^3 \rightarrow \pi^- + H^3$ and ${}_{\Lambda}H^4 \rightarrow \pi^- He^4$ relative to the total number of ${}_{\Lambda}H^3$ and ${}_{\Lambda}H^4$ mesic decays, respectively, are presented. Preliminary results were reported elsewhere. Unbiased data will be available on a total of about 110 ${}_{\Lambda}H$ events, having hyperfragment ranges > 20 μ. Possible biases may arise from (a) different detection efficiencies for the various decay configurations, (b) escape from stack or interaction of the decay pions, and (c) events of ambiguous identification. These are taken into account by (a) determining the relative efficiencies of various decay modes evaluated from coincidences in repeated scannings, (b) determining the incomplete pion residual from blob count, and (c) measuring Z and A of the primary track as well as using the known binding energies of ${}_{\Lambda}H^3$ and ${}_{\Lambda}H^4$ as a discrimination factor.

458

Chicago U. [Enrico Fermi Inst. for Nuclear Studies] Ill.

SEARCH FOR HYPERFRAGMENTS SIMULATING Σ^- CAPTURE (Abstract), by O. Skjeggestad, R. G. Ammar and others. [1960] [1]p. [AF 49(638)209]
Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 12, Jan. 27, 1960.

A systematic search has been undertaken to discover whether among particles emitted from K^- capture in nuclear emulsion, there are particles more massive than Σ^- which simulate the appearance of a Σ^- star. Only those events with connecting tracks ≥ 1 mm and dip angles < 30° will be discussed; prongs from K^- capture are traced through the stack in order to include those events not contained in a single pellicle (1200-μ thick K5 emulsion). Particle masses are determined from gap-length vs range measurements, carried out on microscopes equipped with mechanized stages. Results of measurements on ≥ 50 events will be reported both with a view towards the detection of a possible (Σ^-n) compounds as well as nonmesic decays of ${}_{\Lambda}H$. To date one example of the latter type of event has been identified.

459

Chicago U. Inst. for the Study of Metals, Ill.

DIFFUSION IN SOLIDS AND LIQUIDS AND THE PROPERTIES OF SUBSTANCES AT HIGH TEMPERATURES, I. POINT IMPERFECTIONS IN METALS BY

CONDUCTIVITY AND DIFFUSION MEASUREMENTS, II. OPTICAL PROPERTIES OF METALS, III, by N. H. Nachtrieb, C. T. Tomizuka and L. G. Schulz. Final rept. July 1, 1955-Dec. 31, 1959 [175]p. incl. diagrs. tables, refs. (AFOSR-TR-60-23) (AF 18(600)1489) AD 232543; PB 145836 Unclassified

This report represents the completion of work performed in three areas of metallurgy. Some topics discussed are self-diffusion in homogeneous solid solutions, diffusion in liquid metals, exploratory experiments on the possibility of quenching-in defects in metals under hydrostatic pressure and optical properties of alloys.

460

Chicago U. Inst. for the Study of Metals, Ill.

ON THE DYNAMICAL THEORY OF DIFFUSION IN CRYSTALS. III. SOME MODEL CALCULATIONS AND RELATION TO CONTINUUM THEORY, by A. W. Lawson, S. A. Rice and others. [1959] [9]p. incl. tables, refs. (AF 18(600)1489) Unclassified

Also published in Jour. Chem. Phys., v. 32: 447-455, Feb. 1960.

In previous investigations consideration of the frequency with which the diffusing atom exceeded a critical amplitude simultaneously with the occurrence of a properly phased motion of the neighboring shell atoms lead to the following expression for the diffusion coefficient: $D = \gamma a^2 \gamma_\varphi \exp(-U_0/kT) \prod \exp(-U_j/kT) \prod g_{kl}$. Here, attention is directed towards the dynamical theory from the point of view of some simple models. The various terms in the above equation are examined systematically to clarify the physical basis of the theory and to develop approximate methods of numerical evaluation. The simple models proposed indicate the following: (1) there is relaxation about a vacancy, (2) jump frequency is insensitive to the normal mode modification produced by the adjacent vacancy, (3) ordinary elastic constants are an accurate means of calculating the free energy of vacancy formation, (4) the volume change on vacancy formation should be 1/2 the molal volume, and (5) the correlation energy is a small fraction of the total E_{act}.

461

Chicago U. [Inst. for the Study of Metals] Ill.

SELF-DIFFUSION IN SILVER UNDER HYDROSTATIC PRESSURE UP TO 8000 ATM.(Abstract), by C. T. Tomizuka, R. C. Lowell, and A. W. Lawson. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)1489] and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 181, Mar. 21, 1960.

It is generally accepted that the activation volume for self-diffusion is closely related to the actual volume of a mole of moving vacancies. Experimental determination of the activation volume for self-diffusion was successfully carried out in lead, sodium, and white phosphor earlier by Nachtrieb and his co-workers. Similar experiments in noble metals would yield quantitative information regarding the nature of defects responsible for diffusion. In view of the requirement of high temperature the present experiment was carried out in a pressurized argon gas system. The standard tracer techniques and lathe sectioning procedure were used for the determination of diffusion coefficients. The results so far obtained on silver single crystals indicate that the amount of relaxation of atoms surrounding a vacancy is somewhat smaller than that which is consisted to exist in other materials and than the amount expected from existing theories.

462

Chicago U. [Inst. for the Study of Metals] Ill.

FEASIBILITY OF QUENCHING LATTICE DEFECTS IN NOBLE METALS UNDER HYDROSTATIC PRESSURE (Abstract), by R. C. Lowell and C. T. Tomizuka. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)1489] and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 182, Mar. 21, 1960.

In order to investigate the possibility of determining the activation volume for the formation of point defects directly through a series of quenching experiment as a function of hydrostatic pressure, a natural cooling rate of a heated platinum wire was measured under pressure up to 8500 atm. It was found that the quenching rate from 1050°C was reasonably constant in the pressure range of 3000 to 8500 atm. The observed quenching rate of 10^4 deg/sec is sufficiently large to permit the proposed experiment.

463

Chicago U. Inst. for the Study of Metals, Ill.

A STUDY OF THE IONIZATION OF POLYSTYRENE SULFONIC ACID BY PROTON MAGNETIC RESONANCE, by L. Kotin and M. Nagasawa. [1960] [11]p. incl. diagrs. refs. (AFOSR-TN-60-1248) (Sponsored jointly by Air

Force Office of Scientific Research under AF 49(638)-694 and National Institutes of Health) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 1026-1028, 1961.

The true degree of ionization of polystyrene sulfonic acid is determined by means of the proton magnetic resonance technique and is compared with the apparent degree of ionization determined by pH measurements. The magnitude of the slope of the straight line obtained in the customary plot of the chemical shift versus the stoichiometric mole fraction of acidic hydrogen is found to be 11.5 ± 0.3 which indicates that the acid is completely ionized.

464

Chicago U. Inst. for the Study of Metals, Ill.

IMPURITY CONDUCTION IN TRANSMUTATION-DOPED p-TYPE GERMANIUM, by H. Fritzsche and M. Cuevas. Apr. 4, 1960 [8]p. incl. diagrs. tables, refs. (AFOSR-TN-60-421) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)802, Atomic Energy Commission, and National Science Foundation) AD 612517 Unclassified

Also published in Phys. Rev., v. 119: 1238-1245, Aug. 15, 1960.

The Hall coefficient and resistivity of germanium single crystals bombarded with slow neutrons were measured between 1.2 and 300°K. Slow neutron capture and subsequent nuclear transmutation produce majority impurities, gallium atoms, and compensating impurities, arsenic and selenium atoms. p-Type samples with a gallium concentration ranging from 8×10^{14} to 5×10^{17} per cc with a fixed compensation ratio of 0.40 were thus prepared, and the impurity conduction was studied as a function of the average distance between the majority impurities. The effective radius a of the acceptor ground-state wave function is 90.1 A according to Miller's theory of impurity conduction, whereas a = 40 A according to Twose's theory. The latter value agrees well with the effective radius of the Kohn-Schechter acceptor wave function. The activation energy of impurity conduction changes slowly with impurity concentration from 3.5×10^{-4} to 5.9×10^{-4} ev and agrees well with the predictions of Miller's theory for gallium concentration below 5×10^{15} per cc. Measurements on samples which contain different dislocation densities but identical impurity concentrations show that up to 10^4 dislocations per cm^2 do not affect impurity conduction. (Contractor's abstract)

465

Chicago U. Inst. for the Study of Metals, Ill.

EFFECT OF SHEAR ON IMPURITY CONDUCTION IN n-TYPE GERMANIUM, by H. Fritzsche. May 6, 1960 [2]p. incl. diagrs. refs. (AFOSR-TN-60-627) (AF 49-(638)802) Unclassified

Published in Phys. Rev., v. 119: 1899-1900, Sept. 15, 1960.

Shear strains, which change the donor wave functions, greatly affect impurity conduction, which depends sensitively on the wave function overlap of neighboring impurity states. The change of impurity conduction of germanium containing 5.2×10^{15} antimony atoms per cc and about 3% compensation was measured at 1.9°K as a function of shear strains produced by uniaxial tension and compression along [110]. It is shown that the anisotropy and the saturation of the conductivity changes observed at stresses larger than 4×10^8 dynes/cm^2 can be understood from the strain induced changes of the donor state wave functions. (Contractor's abstract)

466

Chicago U. Inst. for the Study of Metals, Ill.

VALLEY-ORBIT SPLITTING OF ANTIMONY IN GERMANIUM, by H. Fritzsche. [1960] [5]p. incl. diagrs. tables, refs. (AFOSR-TN-60-709) (AF 49(638)802) Unclassified

Also published in Phys. Rev., v. 120: 1120-1124, Nov. 15, 1960.

The change of electrical conductivity under uniaxial tension and compression has been measured over the range of 4°K to 7°K for single-crystal specimens of germanium doped with antimony. The stress was varied from 1×10^7 to 5×10^8 dynes/cm^2. On the basis of Price's calculation of the effect of shear on the Kohn-Luttinger donor level structure, an expression for the piezoresistance has been derived, which includes terms of high order in the strain. It is shown that for a finite valley-orbit splitting, i.e., a finite energy separation between the onefold and the threefold 1s-like donor states, shear increases the total electron concentration in the conduction band. For uniaxial stresses along the [110] direction this increase in electron concentration is an even function of stress and can, therefore, be determined from a linear combination of the piezoresistance measured under tension and compression. A comparison of the theoretical expression with the experimentally obtained change in electron concentration yields for antimony in germanium a valley-orbit splitting of 0.57 ± 0.03 milli-electron volt.

467

Chicago U. Inst. for the Study of Metals, Ill.

INVESTIGATION OF IMPURITY CONDUCTION IN TRANSMUTATION-DOPED GERMANIUM, by H. Fritzche and M. Cuevas. [1960] [3]p. incl. diagrs. (AFOSR-3337) [AF 49(638)802] Unclassified

Also published in Proc. Internat'l. Conf. on Semiconductor Physics, Prague (Czechoslovakia) (Aug. 29-Sept. 2, 1960), Prague, Publishing house of the Czechoslovak Academy of Sciences, 1961, p. 222-224.

Gallium and arsenic impurities were introduced into pure and previously doped Ge by slow neutron irradiation and subsequent nuclear transmutation. Three problems were studied. (1) The dependence of impurity conduction on the average impurity separation for fixed compensation K. (2) The transition to metallic impurity conduction. (3) The K dependence of the activation energy of impurity conduction. The results are compared with Miller's theory and the orbit radius of the acceptor is deduced. (Contractor's abstract)

468

Chicago U. Lab. of Molecular Structure and Spectra, Ill.

TECHNICAL REPORT 1957-9, PART II. [1959] [262]p. incl. diagrs. tables, refs. (AFOSR-TN-60-9) (Sponsored jointly by Air Force Cambridge Research Center under AF 19(604)1019 and AF 19(604)3478; Air Force Office of Scientific Research under AF 18(600)471, Office of Naval Research under Nonr-212101, and Office of Ordnance Research under DA-11-022-ORD-1002) AD 232111 Unclassified

This report represents a collection of 22 papers emphasizing methods and results from work using electronic digital computers. Some topics discussed are molecular structure, correlated atomic orbitals, and electronic wave functions.

469

Chicago U. [Lab. of Molecular Structure and Spectra] Ill.

ELECTRON POPULATION IN CO_2 AND C_2H_2 (Abstract), by A. D. McLean, B. J. Ransil, and R. S. Mulliken. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)471], National Science Foundation, and Office of Ordnance Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 155, Mar. 21, 1960.

Electron population analyses have been carried out on the single-determinantal LCAO-MO-SCF wave functions for CO_2 and C_2H_2 computed by A. D. McLean. The electronic structure of CO_2 and C_2H_2 will be discussed in terms of atomic and overlap populations, including computed values of the charges on the atoms and of the extent of s-p hybridization of C and O atoms in the various bonds. The structures of C_2H_2 and N_2 will be compared.

470

Chicago U. [Lab. of Molecular Structure and Spectra] Ill.

ELECTRONIC PROPERTIES OF SELECTED DIATOMIC MOLECULES (Abstract), by S. Fraga and B. J. Ransil. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)471], National Science Foundation, and Office of Ordnance Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 155, Mar. 21, 1960.

Configuration interaction has been applied to single-determinantal functions for LiH, BH, NH, Li_2, Be_2, C_2, N_2, F_2, CO, BF, and LiF computed previously by Ransil. The total computed molecular energies, dissociation energies, and dipole moments will be discussed and compared to available experimental data.

471

Chicago U. [Lab. of Molecular Structure and Spectra] Ill.

POTENTIAL CURVES FOR H_2, He_2^{++}, He_2, AND Ne_2 (Abstract), by B. J. Ransil. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)471], National Science Foundation, and Office of Ordnance Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 155, Mar. 21, 1960.

Wave functions, the corresponding total molecular energy, and orbital energies have been computed for the lowest $^1\Sigma g^+$ states of H_2, He_2^{++}, He_2, and Ne_2 in LCAO-MO-SCF approximation utilizing an extended basis set 1s, 1s, 2pσ; 2pπ for the neon calculation. Curves for both the single-determinantal and configuration-interaction approximations will be discussed. Comparisons to previous calculations and experimentally derived curves will be made providing some insight into the relation of functional accuracy to the degree of approx employed.

472

Chicago U. [Lab. of Molecular Structure and Spectra] Ill.

CONFIGURATION INTERACTION IN THE HYDROGEN MOLECULE. THE GROUND STATE, by A. D. McLean, A. Weiss, and M. Yoshimine. [1960] [17]p. incl. diagrs. tables, refs. (Bound with its AFOSR-TN-60-9; AD 232111; PB 154277) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)471 AND National Science Foundation) Unclassified

Presented at Conf. on Molecular Quantum Mech., Colorado U., Boulder, June 21-27, 1959.

Also published in Rev. Modern Phys., v. 32: 211-218, Apr. 1960.

Various configuration interaction wave functions for the hydrogen molecule ground state have been investigated, using Slater type atomic orbitals (n = 1,2) as basis functions. The best results, obtained with a 5 configuration function, yield a binding energy of 4.5431 ev. A potential energy curve has been computed, from which the spectroscopic constants were calculated. (Contractor's abstract)

473

Chicago U. Lab. of Molecular Structure and Spectra, Ill.

STUDIES IN MOLECULAR STRUCTURE. II. LCAO-MO-SCF WAVE FUNCTIONS FOR SELECTED FIRST ROW DIATOMIC MOLECULES, by B. J. Ransil. [1960] [23]p. incl. tables. (Bound with its AFOSR-TN-60-9; AD 232111; PB 154277) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)-471, National Science Foundation, and Wright Air Development Center) Unclassified

Presented at Conf. on Molecular Quantum Mech., Colorado U., Boulder, June 21-27, 1959.

Also published in Rev. Modern Phys., v. 32: 245-254, Apr. 1960.

Ground state wave functions, total energies and orbital energies are tabulated for selected 1st row hydrides (AH) and diatomics (A_2 and AB) with closed shell ground states in a single determinantal approx. Slater-type atomic orbitals (principal quantum number n = 1,2) are utilized with orbital exponents determined both by Slater's rules and by the variational principle. The tabulated results included dipole moments. (Contractor's abstract)

474

Cincinnati U. Dept. of Chemistry, Ohio.

THE KINETICS AND MECHANISM OF THE REACTION OF BOROHYDRIDES WITH WEAK ACIDS, by R. E. Dessy and E. Grannen, Jr. Nov. 1960 [23]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1467) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)824, Research Corp. and Texaco Co.) AD 252173 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3953-3958, Oct. 5, 1961.

The mechanism of the reaction of $NaBH_4$ and φOH in diglyme to yield hydrogen and sodium phenoxyborohydride has been investigated and found to obey the rate law $\frac{d(H_2)}{dt} = \frac{k(\varphi OH)^2(NaBH_4)}{(\varphi ONa)}$. Evidence indicates that $\varphi OH_2^{\oplus}$ is the attacking species; k_H/k_D (φOH) is 1.7. The reaction of $LiBH_4$ with CH_3OH is similar in character; k_H/k_D ($LiBH_4$) is 0.63. These isotope effects along with the fact that the rate of reaction of $LiBH_4$ with HA increases along the series C_5H_6, C_4H_5N, t - BuOH, CH_3OH, as HA is varied, while the K_a's of the acids increase along the series C_4H_5N, t - BuOH, CH_3OH, C_5H_6, suggests a four-center transition state for the reactions. (Contractor's abstract)

475

Colorado U. Dept. of Chemistry, Boulder.

INERTNESS OF TETRACHLOROFULVENES IN THE DIELS-ALDER REACTION, by J. S. Meek and P. Argabright. [1957] [3]p. (AF 18(600)648) Unclassified

Published in Jour. Org. Chem., v. 22: 1709-1710, Dec. 1957.

1,2,3,4-Tetrachloro-6-phenylfulvene and 4 of its derivatives were kinetically studied. These fulvenes gave no evidence of reaction with maleic anhydride in benzene. The stability of these compounds was reaffirmed in several heating experiments. Certain of the inert results were surprising since it was thought that these compounds contained a reactive diene. However, even in reactions that had been shown to respond to a diene, the fulvenes remained stable.

476

Colorado U. Dept. of Chemistry, Boulder.

THE THERMOCHEMISTRY AND PHOTOCHEMISTRY OF ORGANIC HALOGEN COMPOUNDS, by R. Burkhart, H. B. Gottlieb and others. Final rept. Sept. 6, 1960 [96]p. incl. diagrs. tables, refs. (AFOSR-TR-60-126) (AF 49(638)241) AD 245663 Unclassified

The three parts of research under this contract are

reviewed. The studies on the kinetics of the photobromination of trifluorobromoethylene have shown that the facts concerning the induction period cannot be satisfactorily explained by assuming that it occurs entirely as a result of impurities in the reactions. It is concluded that the major process for chain termination during the induction period is the recombination of bromine atoms while the major chain terminating reaction during the steady state is a recombination involving radicals. The steady state portion of the reaction, however, appears not to be a bromine atom recombination. A proposed mechanism is advanced which is dependent upon stabilization of the radical by a third radical. The photochlorination of this same compound was also studied. The kinetics of this reaction depend on the volume to surface ratio of the reaction cell. It is indicated that no third body is necessary for the chain termination step to take place. The third section of study, flames produced by burning fluorine-containing olefins, discusses the luminescence of several different reactions.

477

Colorado U. [Dept. of Mathematics] Boulder.

ON THE CONVERGENCE OF THE EVEN PART OF CERTAIN CONTINUED FRACTIONS, by W. J. Thron. [1960] [7]p. (AFOSR-TN-60-764) (AF 49(638)100) AD 240163 Unclassified

The following theorem is proved: Let a be an arbitrary complex number and let $\rho > |a|$, $\rho \geq |1 + a|$, and $\epsilon > 0$. Let the elements a_n of the continued fraction $1 + a_1/1 + a_2/1 + \ldots$ satisfy the conditions $a_{2n-1} = c_{2n-1}^2$, $|c_{2n-1} \pm ia| \leq \rho$, $a_{2n} = c_{2n}^2$, $|c_{2n} \pm i(1 + a)| \geq \rho$, and $|a_{2n}| \geq \rho^2 - |1 + a|^2 + \epsilon$. Then the even part of the continued fraction (i.e., the sequence of its even approximants) converges to a value v which satisfies the condition $|v - (1 + a)| \leq \rho$.

478

Colorado U. [Dept. of Mathematics, Boulder].

INFINITE RADICALS IN THE COMPLEX PLANE, by G. Schuske and W. J. Thron. [1960] [10]p. (AFOSR-TN-60-909) (AF 49(638)100) AD 241682; PB 150195 Unclassified

Also published in Proc. Amer. Math. Soc., v. 12: 527-532, Aug. 1961.

If $\{a_n\}$ is a sequence of complex numbers, the sequence $\{u_n\}$, where $u_n = \sqrt{a_1 + \sqrt{a_2 + \ldots \sqrt{a_n}}}$, is called an infinite radical. The numbers a_j are called elements of the infinite radical, and the u_j are called partial radicals. The purpose of this paper is to determine conditional convergence regions for sequences $\{a_n\}$ with complex elements. The Stieltjes-Vitali Theorem for normal families of functions is used, together with Herschfeld's criterion for infinite radicals with positive real elements.

479

Colorado U. [Dept. of Mathematics] Boulder.

CONVERGENCE REGIONS FOR CONTINUED FRACTIONS AND CERTAIN OTHER INFINITE PROCESSES, by W. J. Thron. [1960] 33p. incl. refs. (AFOSR-TN-60-1091) (AF 49(638)100) AD 243470; PB 152071 Unclassified

Also published in Amer. Math. Monthly, v. 68: 734-750, Oct. 1961.

This paper contains a summary of the theory developed by this author and others concerned with continued fractions and certain other infinite processes. It is based on a method of generalized iteration: Let $t_n(z) = f(a_n, z)$, where z is a complex variable and the a_n are complex parameters; define $T_1(z) = t_1(z)$, $T_n(z) = T_{n-1}(t_n(z))$; and then with the proper choice of c form the sequence $\{T_n(c)\}$. Thus when $t_n(z) = a_n/(1 + z)$ and $c = 0$, the continued fraction $K(a_n/1)$ is obtained; with $t_n(z) = 1/(b_n + z)$ and $c = 0$, the continued fraction $K(1/b_n)$ is obtained; with $t_n(z) = (z + a_n)^{\frac{1}{2}}$ and $c = 0$, the infinite radical $\sqrt{a_1 + \sqrt{a_2 + \ldots}}$, etc. This approach has led to a great number of results concerning regions of convergence, and the present paper proves a number of these theorems in the field of continued fractions, and also one on infinite radicals. Among the important tools in this theory, the idea of element regions and value regions and their relation to each other, and the application of the Stieltjes-Vitali convergence theorem to questions of this nature should be mentioned. This paper contains an extensive bibliography on the subject. (Math. Rev. abstract)

480

Colorado U. Dept. of Physics, Boulder.

NUCLEAR RESONANCE OF Al IN SYNTHETIC RUBY, by W. H. Tanttila, W. J. Veigele, and C. M. Verber. June 1960, 5p. incl. tables. (AFOSR-TN-60-724) (AF 49(638)611) AD 239854; PB 149837 Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 344, June 15, 1960. (Title varies)

The quadrupole coupling constant $\Delta\nu$ and the line widths of Al were investigated at 300°K, 77°K, and 4.2°K and Cr^{3+} impurity concentrations of 0.1%, 1.5%, and 4%. The value of $\Delta\nu = 179.6 \pm 1$ kcps at 300°K agreed with that obtained by Pound (1950). It was found that $\Delta\nu$ decreased 3 kcps with a decrease in T from 300°K to 4.2°K and was independent of the Cr^{3+} concentration. The average line widths increased 1 kcps with a decrease in T from 300°K to 77°K and 3 kcps with a decrease in T from 300°K to 4.2°K and were dependent upon the impurity concentration such that there was an increase in line width of 7 kcps for the 4% crystal when T was decreased from 300°K to 4.2°K. The results indicated that the most significant contribution to the line width was the nuclear dipole-dipole interaction except for the 4% crystal at 4.2°K where the paramagnetic dipole-nuclear dipole interaction became important. (Contractor's abstract)

481

Colorado U. Dept. of Physics, Boulder.

INTERRUPTION OF NUCLEAR SPIN DIFFUSION, by D. A. Jennings and W. H. Tanttila. Oct. 1960 [11]p. incl. diagr. refs. (AFOSR-TN-60-1184) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)611 and National Science Foundation)
AD 246515 Unclassified

Presented at meeting of the Amer. Phys. Soc., California U., Berkeley, Dec. 29-31, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 498, Dec. 29, 1960.

Also published in Jour. Chem. Phys., v. 37: 1874-1876, Oct. 15, 1962.

Experimental results are shown in which the nuclear spin diffusion responsible for nuclear relaxation at low temperature, under certain circumstances, can be interrupted by introducing strains into crystals either by the paramagnetic impurity introduced into the crystal or by surface strains made to be significant by grinding the sample to a powder. Nuclei with large quadrupole moments, such as iodine, have their spin diffusion strongly interrupted whereas nuclei with no quadrupole moment, such as fluorine, show no effect of strains on the spin diffusion. The interpretations are made from measured values of the spin-lattice relaxation time at liquid helium temperature. (Contractor's abstract)

482

Columbia U. Columbia Radiation Lab., New York.

GENERATION OF MICROWAVES BY CERENKOV RADIATION, by H. Lashinsky. [1959] [10]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-73279]) Unclassified

Published in Proc. Symposium on Millimeter Waves, New York, N. Y. (Mar. 31-Apr. 2, 1959), Brooklyn, Polytechnic Inst. of Brooklyn Press [1960] p. 181-190.

A description is given of an experiment being undertaken to explore the generation of millimeter waves by Cerenkov radiation. A magnetically focussed, high-density, ribbon electron beam grazes the surface of a dielectric (TiO_2, $\epsilon \sim 100$) at a velocity which satisfies the Cerenkov condition (beam voltage = 10 kv). First the beam passes through a bunching cavity which is driven by an external K-band source. Thus the Cerenkov radiation is excited at the bunching frequency and its harmonics. Radiation at the fundamental frequency has been observed in an earlier version of this experiment; the experiment described here has been designed to facilitate a search for harmonics up to the millimeter region. Measures taken to minimize beam perturbations and to achieve good alignment are described. Problems involved in coupling the radiation out of the dielectric and in the detection of this radiation are discussed. (Contractor's abstract)

483

Columbia U. [Columbia Radiation Lab.] New York.

LIMITS ON ELECTROMAGNETIC AMPLIFICATION DUE TO COMPLEMENTARITY, by R. Serber and C. H. Townes. [1959] [23]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, and Signal Corps under [DA 36-039-sc-73279])
Unclassified

Published in Quantum Electronics; A Symposium, High View, N. Y. (Sept. 14-16, 1959), New York, Columbia U. Press, 1960, p. 233-255.

The complementarity between phase φ and number of photons n in an electromagnetic wave gives an approximate uncertainty relation $\Delta n \Delta\varphi \geq \frac{1}{2}$ which limits the performance of any amplifier. An ideal maser-type amplifier introduces uncertainties $\frac{1}{2\sqrt{n}}$ and $\sqrt{n+1}$ in determination of φ and n respectively, or hence allows the limiting uncertainty product $\Delta n \Delta\varphi = \frac{1}{2}$ if n is large enough for phase to be adequately defined. The minimum fluctuations introduced by the amplifying process itself correspond more precisely to equal magnitudes for the uncertainty in electric and magnetic fields while the product of these uncertainties has the minimum allowable value. These uncertainties can be connected with zero-point fluctuations of the fields. Ideal detectors which allow in principle $\Delta n = 0$, $\Delta\varphi \to \infty$ or $\Delta\varphi \to 0$, $\Delta n \to \infty$ may be combined with each other or with a maser amplifier to allow all possible ratios of Δn and $\Delta\varphi$ while the relation $\Delta n \Delta\varphi = \frac{1}{2}$ is still satisfied. (Contractor's abstract)

484

Columbia U. [Columbia Radiation Lab.] New York.

MOLECULAR BEAM FORMATION BY LONG PARALLEL TUBES, by J. A. Giordmaine and T. C. Wang. [1959] [11]p. incl. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-73279]) Unclassified

Published in Quantum Electronics; A Symposium, High View, N. Y. (Sept. 14-16, 1959), New York, Columbia U. Press, 1960, p. 67-77.

Also published in Jour. Appl. Phys., v. 31: 463-471, Mar. 1960.

The results of a theoretical study of beam formation are summarized and compared with observations of beams from several types of sources. It is shown that for an array of tubes of given overall area, the peak intensity for fixed flow varies as $a^{-\frac{1}{2}}$, where a is the radius of a single tube, while the beam width varies as $a^{+\frac{1}{2}}$. The collimation therefore increases as the diameter of the individual tubes is reduced. The optimum tube diameter is probaoly of the order of 10^{-3} in., since at this diameter the tube walls usually begin to occupy a large fraction of the source cross section. It can also be shown that increasing the length of the source beyond a critical length does not improve the collimation.

485

Columbia U. Columbia Radiation Lab., New York.

USE OF SOME NEW MOLECULES IN A BEAM TYPE MASER FOR SPECTROSCOPY AND FREQUENCY STANDARDS, by P. Thaddeus, J. Loubser and others. [1959] [10]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-73279]) Unclassified

Published in Quantum Electronics; A Symposium, High View, N. Y. (Sept. 14-16, 1959), New York, Columbia U. Press, 1960, p. 47-56.

The beam maser was first used as a high resolution spectrometer to resolve the magnetic hyperfine structure due to the 3 protons in the ammonia inversion spectrum. Work at Columbia U. has been primarily directed towards molecules of light asymmetric tops with rotational transitions in the X and Ku band regions. The maser used here utilizes an effuser source of the corrugated foil type, made by feeding a thin ribbon 1 mil thick and about 6 mm wide of stainless steel or nickel foil between 1 and 2 meshed gears which have rectangular teeth 1 to 2 mils deep. The low saturation level of the maser emission lines, typically of the order of 10^{-10} watts, requires very sensitive detection techniques. The superheterodyne system used at Columbia has the advantage of using only 1 klystron. Some molecules of spectroscopic interest which appear to be accessible to the present techniques are CH_2O, CHDO, HDO, NH_2D, HDSe, ClCN, BrCN, ICN, CH_3CN, CH_3Cl, CH_3Br, CH_3I, and C_2H_2O.

486

Columbia U. [Columbia Radiation Lab.] New York.

QUADRUPOLE COUPLING CONSTANT OF THE DEUTERON IN HDS (Abstract), by P. Thaddeus, J. Loubser, and L. Krisher. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-73279]) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 74, Jan. 27, 1960.

A beam-type maser has been used as a microwave spectrometer to resolve the hyperfine structure of the $2_{20} - 2_{21}$ rotational transition of the asymmetric top molecule HDS which lies at 11,283.8 mc. The observed line widths of the various hyperfine components are approximately 5 kc/sec. Assuming symmetry of the electric field gradient tensor at the deuteron about the S-D bond, a value of 149 ± 10 kc/sec for χ, the quadrupole coupling constant along the bond, has been required to give a best theoretical fit to the observed spectrum. Substantial magnetic effects of both the H and D nuclei have also been detected.

487

Columbia U. [Columbia Radiation Lab.] New York.

NEW METHOD FOR PARAMAGNETIC RELAXATION TIME MEASUREMENTS (Abstract), by J. A. Giordmaine. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-73279]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago U., Ill., Nov. 25-26, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 418, Nov. 25, 1960.

Relaxation times T_1 have been measured by a method in which microwave saturating power is amplitude-modulated at an audio frequency ω. The phase difference φ between the power modulation and the resulting modulation of a reflected signal proportional to the imaginary part of the susceptibility is measured as a function of ω. For a single relaxation time tan φ has a maximum

value of $2WT_1(1-4W^2T_1^2)^{-\frac{1}{2}}$ occurring when ω is $(1/T_1)(1-4W^2T_1^2)^{\frac{1}{2}}$. W is the rf-induced transition probability. From the frequency and magnitude of the maximum phase difference, T_1 is obtained at a particular spin temperature. This method, which involves only measurements of audio frequency and phase, is convenient and appears to be capable of higher precision than other microwave methods. It is particularly sensitive to distribution of T_1. Results are reported for Cr^{+3} impurities in ruby at 78°K where both single and multiple relaxation times are observed for various transitions at X band.

488

Columbia U. Columbia Radiation Lab., New York.

CROSS SECTIONS FOR THE EXCITATION OF THE METASTABLE 2s STATE OF ATOMIC HYDROGEN BY ELECTRON COLLISION, by W. Lichten and S. Schultz. [1959] [31]p. incl. diagrs. table, refs. (AFOSR-TN-60-447) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1334, Office of Naval Research under Nonr-26645, and Signal Corps)
AD 236969 Unclassified

Presented at Fourth Brookhave Conf. on Molecular Beams, Heidelburg U. (Germany), June 9-11, 1959.

Presented at meeting of the Amer. Phys. Soc., Rice Inst., Houston, Texas, Mar. 4-5, 1960.

Also published in Phys. Rev., v. 116: 1132-1139, Dec. 1, 1959.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 120, Mar. 4, 1960.

The function for excitation of the 2s state of atomic hydrogen by electron impact was measured from the threshold to 45 ev by an atomic beam method. The absolute value of the total cross section was determined by 2 independent methods which are in agreement. In 1 method the excitation function was normalized to the Born approximation at the higher energies. The mechanism of cascade from higher p states was found to play a significant role in population of the metastable 2s level. The other method proceeded by determining the metastable detection efficiency in terms of the known efficency for Lyman-α photons. The yield for ejection of electrons from an untreated platinum surface by H(2s) is 0.065 ± 0.025. The total cross section reaches a maximum value of $(0.35 \pm 0.05)\,\pi\,a_0^2$ at 11.7 ev. The exchange cross section was also measured by the atomic beam method. The incident atoms were polarized in a Stern-Gerlach experiment; the metastable atoms were analyzed by the selective quenching action of a magnetic field of 575 gauss. The ratio of the exchange to total cross section is 45 ± 0.05 near threshold. At higher energies, this ratio approaches zero.

489

Columbia U. Columbia Radiation Lab., New York.

BINDING ENERGIES OF ALKALI HALIDE MOLECULES by G. M. Rothberg. [1959] [10]p. incl. diagrs. tables, refs. (AFOSR-620) [AF 18(600)1334] Unclassified

Also published in Jour. Chem. Phys., v. 34: 2069-2078, June 1961.

The repulsive part of the energy of interaction of an alkali ion and a halogen ion may be written $fe^{-z/r}$, where f and r are constants appropriate to the ions, and z is the internuclear distance. In alkali halide crystals and monomers, f and r may be determined empirically, but in the case of the dimers the necessary data are lacking. In this paper the repulsive energy is examined qualitatively with use of the Thomas-Fermi model, and an approximation is found for the dimer constants that enables accurate calculations to be made of the binding energies of the dimers. (Contractor's abstract)

490

Columbia U. Columbia Radiation Lab., New York.

HYPERFINE STRUCTURE OF THE $6\,^3P_2$ STATE OF $_{80}Hg^{199}$ AND $_{80}Hg^{201}$. PROPERTIES OF METASTABLE STATES OF MERCURY, by M. N. McDermott and W. L. Lichten. [1960] [10]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)1334], Office of Naval Research, and Signal Corps) Unclassified

Presented at Fourth Brookhaven Conf. on Molecular Beams, Heidelburg U. (Germany), June 9-11, 1959.

Published in Phys. Rev., v. 119: 134-143, July 1, 1960.

The hyperfine structure of the metastable $6\,^3P_2$ state of Hg^{199} and of Hg^{201} have been measured by means of the atomic-beam magnetic resonance technique. The present experiment is the first one for which the electron bombardment method has been used in the production of a narrowly collimated beam of metastable atoms. The beam was detected by surface ejection of electrons from an alkali metal surface. The zero magnetic field intervals $f(F \rightarrow F^1)$ are: for Hg^{199} $f(5/2 \rightarrow 3/2) = 22\,666.559(5)$ mc/sec; and for Hg^{201} $f(7/2 \rightarrow 5/2) = 11\,382.6286(8)$ mc/sec, $f(5/2 \rightarrow 3/2) = 8629.5218(5)$ mc/sec, and $f(3/2 \rightarrow 1/2) = 5377.4918(20)$ mc/sec. The values of the quadrupole and octupole moments of Hg^{201} are, without polarization corrections, $Q = 0.50(4) \times 10^{-24}$ cm^2 and $\Omega = 0.13$ nuclear magneton barn. The hyperfine structure anomaly for the two isotopes due to the s electron alone is $\Delta\,(s_{1/2}) = -0.1728(12)\%$ in disagreement with the predictions of the single particle model. The

gJ values for the $^3P_2$ state and the $(5d^9 6s^2 6p)^3D_3$ state were found to be $gJ(^3P_2) = 1.50099(10)$ and $gJ(^3D_3) = 1.0867(5)$. The value of J = 3 for the $^3D_3$ state was confirmed. A new technique for obtaining excitation functions is discussed. (Contractor's abstract)

491

Columbia U. Columbia Radiation Lab., New York.

VELOCITY ANALYSIS OF MOLECULAR BEAMS GENERATED FROM NaOH VAPORS, by V. S. Rao and R. C. Schoonmaker. Feb. 27, 1961 [3]p. incl. diagrs. table, refs. (Rept. no. CU-4-60 AF 557) (AFOSR-TN-60-518) (AF 49(638)557) AD 251559 Unclassified

Also published in Jour. Chem. Phys., v. 33: 1718-1720, Dec. 1960.

A molecular beam velocity analysis technique was employed to determine the molecular composition of vapors in equilibrium with liquid sodium hydroxide in the temperature range 887-990°K. The experimental results are nonreproducible to an extent which far exceeds the expected experimental uncertainties. It is inferred that this anomalous behavior is characteristic of the NaOH system and several possible explanations for the discrepancies are discussed. (Contractor's abstract)

492

Columbia U. Columbia Radiation Lab., New York.

HYPERFINE STRUCTURE OF THE METASTABLE $^3P_2$ STATE OF Cd^{111} AND Cd^{113}, by W. Faust, M. McDermott, and W. [L.] Lichten. [1960] [1]p. incl. table. (AFOSR-TN-60-612) (AF 49(638)557) AD 251338 Unclassified

Published in Phys. Rev., v. 120: 469, Oct. 15, 1960.

The hyperfine intervals of Cd^{111} and Cd^{113} (5s, 5p, $^3P_2$) are $\Delta\nu^{111}$ (F = 5/2, F = 3/2) = (8232.341 ± 0.002) mc/sec; $\Delta\nu^{113}$ (F = 5/2, F = 3/2) = (8611.586 ± 0.004) mc/sec. The measured hyperfine anomaly is (0.0016 ± 0.0003)%. (Contractor's abstract)

493

Columbia U. Columbia Radiation Lab., New York.

SOME STUDIES INVOLVING THE COMPLEXES OF THE ALKALI HALIDES, by P. Kusch. Feb. 27, 1961 [10]p. incl. diagrs. (Rept. no. CU-1-60 AF 557) (AFOSR-TN-60-659) (AF 49(638)557) AD 251659 Unclassified

Presented at Atomic and Molecular Beams Conf., Denver, Colo., June 20-22, 1960.

The alkali halides and the divalent halides of Fe, Co and Ni form complexes when the 2 salts are heated together. They may be distinguished from each other, in a molecular beams apparatus equipped with inhomogeneous deflecting magnetic fields, through the fact that the alkali halide has a very small magnetic dipole moment, of the order of a nuclear magneton, while the complex has a mean magnetic dipole moment much greater than the nuclear magneton and much less than the Bohr magneton. The complex is the dominant component in the vapor. While present techniques do not allow the measurement of the relative abundances of all 3 components in the vapor phase, it is possible to obtain good values of the energy of dissociation of the complex into its 2 basic components. The mean magnetic dipole moment of the complex can also be found.

494

Columbia U. Columbia Radiation Lab., New York.

KINETIC AND THERMODYNAMIC STUDIES OF THE VAPORIZATION OF SOME ALKALI METAL SALTS, by V. S. Rao. Feb. 21, 1961 [18]p. incl. diagrs. tables, refs. (Rept. no. CU-2-60 AF 557) (AFOSR-TN-60-660) (AF 49(638)557) AD 251658 Unclassified

Presented at Atomic and Molecular Beams Conf., Denver, Colo., June 20-22, 1960.

A high resolution molecular beam velocity selector has been used in the investigation of the molecular composition and thermochemical properties of the vapors of some alkali metal salts. From an analysis of the distribution of velocities among molecules effusing from an isothermal enclosure with an ideal aperture, it has been found that monomers and polymers exist in measurable quantities in the vapor phase in equilibrium with the condensed phase. In one case, the molecular beams have been tested for the presence of atomic components. Vapor pressures, heats of vaporization and of polymerization have been calculated from the composition of the vapor phase at various temperatures. These values have significance only if chemical equilibrium actually occurs between the various polymeric species within the ovens used in the above studies. Detailed experiments have been performed to obtain evidence for the existence of such an equilibrium process. (Contractor's abstract)

495

Columbia U. Columbia Radiation Lab., New York.

ALKALI-IRON GROUP-HALOGEN COMPLEXES. DISSOCIATION ENERGIES OF $XClFeCl_2$ AND $CsClFeCl_2$, by V. S. Rao and P. Kusch. [1960] [5]p. incl. diagrs. tables. (AFOSR-TN-60-858) (AF 49(638)557) AD 256231 Unclassified

Also published in Jour. Chem. Phys., v. 34: 632-636, Mar. 1961.

A number of complexes between alkali halides and the divalent halides of the iron group metals have been observed. They are characterized by a very large rotational magnetic moment of the order of 50 nuclear magnetons for the rotational state of most probable J. The dissociation energies at a temperature of about 1020°K of the 2 complexes, $KClFeCl_2$ and $CsClFeCl_2$, have been found to be 34.7 ± 1.0 and 24.7 ± 1.0 kcal M^{-1}, respectively. The data from which these results were found were obtained by measuring the relative concentrations of the alkali halide and the complex as a function of temperature while the partial pressure of $FeCl_2$ remained essentially constant. The large difference in the magnetic moments of the 2 detectable molecular species allows the determination of the relative concentration with considerable accuracy. (Contractor's abstract)

496

Columbia U. Columbia Radiation Lab., New York.

LONG RANGE ATTRACTIVE POTENTIALS FROM MOLECULAR BEAM STUDIES ON THE SYSTEMS $K,N_2(g)$ AND $KCl,N_2(g)$, by R. C. Schoonmaker. [1960] [2]p. incl. diagr. (Rept. no. CU-6-62 AF 557) (AFOSR-TN-60-1262) (AF 49(636)557) AD 264617
Unclassified

Also published in Jour. Phys. Chem., v. 65: 692-893, May 1961.

In the present study velocity-selected molecular beams of K and KCl were scattered in a defined region by $H_2(g)$. The results concerning K as beam atom and N_2 gave an average exponent of 6.23 and tend to verify the potential function which is inferred from theoretical considerations. For the KCl, N_2 system, however, an unexpected result was obtained. The value for the exponent which was derived from the average of several runs, $s = 5.30$, implies an inverse fifth power dependence of the potential on the particle separation. The reason for this is not clear. Other results were as expected.

497

Columbia U. Columbia Radiation Lab., New York.

SHEET TYPE POLARIZERS AND RETARDATION PLATES FOR USE IN THE FAR ULTRAVIOLET, by M. N. McDermott and R. Novick. [1960] [3]p. incl. diagrs. refs. [AFOSR-TN-60-1220] [AF 49(638)936]
Unclassified

Also published in Jour. Opt. Soc. Amer., v. 51: 1006-1010, Sept. 1961. (Title varies)

The ultraviolet properties of films that have useful polarizing properties at wavelengths as short as 215 mμ are reported. Large-diameter films may be obtained and the material is not bleached by intense ultraviolet radiation. The use of stretched polyvinyl alcohol and cleaved mica sheets as retardation plates is reviewed. (Contractor's abstract)

496

Columbia U. Columbia Radiation Lab., New York.

OPTICAL DETECTION OF LEVEL CROSSINGS IN $Cd^{111, 113}$ (Abstract), by M. N. McDermott, R. Novick, and P. Thaddeus. [1960] [1]p. [AF 49(636)936]
Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 25-26, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 411-412, Nov. 25, 1960.

The effect on resonance fluorescence of level crossings in a magnetic field, discovered by Franken et al for fine structure components in He, has been observed for hyperfine levels of the $5s5p\,^3P_1$ state of Cd^{111} and Cd^{113}. A single crossing point, expected on the basis of the known values of g_J and A has been found for each isotope with a signal-to-noise ratio of better than 50:1 when using narrow band detection of the 3261A intercombination line fluorescence. Preliminary measurements place the crossing points near 1965 and 2056 gauss for Cd^{111} and Cd^{113} respectively, or within present field uncertainties of the calculated values. The observed line width of about 0.6 gauss, however, contrasts sharply with the 0.05 gauss expected from the 2.5 μsec lifetime of the $^3P_1$ state, and is due to field inhomogeniety. Refinements in line width and field measurement will permit a precise determination of g_J in terms of A for either isotope.

499

Columbia U. Dept. of Chemistry, New York.

HALOGEN BOUND CHARACTER IN THE ALKYL HALIDES, by B. P. Dailey. [1960] [3]p. incl. table. (AFOSR-TN-60-549) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)1152], Alfred P. Sloan Foundation, and National Science Foundation)
Unclassified

Also published in Jour. Chem. Phys., v. 33: 1641-1643, Dec. 1960.

The quantity $(I + s^2)$, the sum of the ionicity and s hybridization, has been calculated from nuclear quadrupole coupling data for 24 alkyl halides. The ionicity has been

estimated independently from calculated values of ϵ_x, the effective charge on the halogen. The average derived values of s^2, the amount of s character in the hybrid halogen bonding orbital, are 13.6% for carbon-chlorine bonds, 8.6% for carbon-bromine bonds, and 1.8% for carbon-iodine bonds. (Contractor's abstract)

500

Columbia U. Dept. of Chemistry, New York.

THE ELECTRON SPIN RESONANCE SPECTRUM OF THE CYCLOOCTATETRAENYL RADICAL ANION, by T. J. Katz and H. L. Strauss. Apr. 1, 1960, 6p. incl. refs. (Technical note no. 4; rept. no. CU-4-60AF520-Chem) (AFOSR-TN-60-589) (AF 49(638)520) AD 242503 Unclassified

Also published in Jour. Chem. Phys., v. 32: 1873-1875, June 1960.

Solutions prepared by treatment of cyclooctatetraene in tetrahydrofuran with up to 2 moles of lithium were examined by the electron spin method, which revealed a spectrum of 9 equally spaced lines in the expected intensity ratios attributable to the hyperfine interaction of the 8 equivalent protons. The presence of the radical anion in solutions prepared by treatment of cyclooctatetraene with potassium metal was similarly indicated by the electron spin resonance spectrum. Here, however, an exchange reaction broadened the hyperfine structure considerably. The observation that such structure could be resolved in solutions of constant cyclooctatetraene concentration only when trace amounts of potassium metal were employed, while broadening to a single unsplit-resonance occurred as larger amounts of potassium were used revealed that rapid exchange of the electrons of the radical anion was occurring not with the hydrocarbon, but with the divalent anion. These findings support the view that the anion radical and the dianion are similar in geometry and unlike the parent hydrocarbon, for the electron exchange between the molecules is subject to the restrictions of the Franck-Condon principle.

501

Columbia U. Dept. of Chemistry, New York.

ANOMALOUS RELAXATION OF HYPERFINE COMPONENTS IN ELECTRON SPIN RESONANCE. II, by J. W. H. Schreurs and G. K. Fraenkel. Aug. 1, 1960 [48]p. incl. diagrs. tables, refs. (Technical note no. 5; rept. no. CU-5-60AF520-Chem) (AFOSR-TN-60-863) (AF 49(638)520) AD 242504 Unclassified

Also published in Jour. Chem. Phys., v. 34: 756-768, Mar. 1961.

The conventional theory of the electron spin resonance spectra of free radicals in solution predicts that the hyperfine components should each have intensities proportional to the degeneracy of the nuclear spin states and should each have the same line width and saturation behavior. In a previous article (item no. 371, Vol. III) a variation in widths and saturation parameters from one component to another was shown. These data raise interesting questions about the mechanisms which produce line broadening and relaxation, and about the theory of saturation in complex multi-level systems. The present work was undertaken to obtain a quantitative description of the line shape, line width, and saturation behavior for comparison with recently formulated theories (item no. 379, Vol. III). Measurements are presented on the spectrum of the p-benzosemiquinone ion and, for comparison purposes, the peroxylamine disulfonate ion.

502

Columbia U. Dept. of Chemistry, New York.

NOTE ON THE CALCULATION OF SATURATION EFFECTS IN MAGNETIC RESONANCE, by M. J. Stephen. Aug. 15, 1960, 16p. incl. diagrs. (Technical note no. 7; rept. no. CU-7-60AF520-Chem) (AFOSR-TN-60-919) (AF 49(638)520) AD 242506 Unclassified

Also published in Jour. Chem. Phys., v. 34: 484-489, Feb. 1961. (Title varies)

A simple method using diagrams is described for calculating saturation parameters in spin systems. Results are derived for the multiresonance case. The lattice is regarded as inducing transitions amongst the various spin levels and the transition probabilities are assumed known. The method is particularly useful in complicated spin systems as are found in organic free radicals. For a free radical in solution with one odd electron and N equivalent nuclei under conditions where the intramolecular electron nuclear dipole-dipole interaction and g factor anisotropy contribute to the relaxation, the dependence of the saturation parameters of the electron resonance spectrum on the nuclear quantum number m_J is given by an expression of the form $Am_J^2 + Bm_J + C$. Such behavior has been found experimentally. (Contractor's abstract)

503

Columbia U. Dept. of Chemistry, New York.

MOLECULAR ORBITAL THEORY AND HYPERFINE SPLITTING IN ELECTRON SPIN RESONANCE SPECTRA OF SEMIQUINONES, by G. Vincow and G. K. Fraenkel. Aug. 15, 1960, 30p. incl. diagrs. tables, refs. (Technical note no. 6; rept. no. CU-6-60AF520-Chem) (AFOSR-TN-60-820) (AF 49(638)520) AD 242505 Unclassified

Also published in Jour. Chem. Phys., v. 34: 1333-1343, Apr. 1961.

Molecular orbital calculations of the unpaired electron density in a number of semiquinone ions were made as a function of a range of values of the Coulomb integral, α_O, for the oxygen atom and the resonance integral, β_{CO}, between the oxygen atom and the carbon atom. The unpaired-electron densities, ρ_i, were compared with the experimental hyperfine splitting constants a_i arising from the proton bonded to carbon atom i by the use of McConnell's relation $a_i = Q\rho_i$. Excellent agreement is obtained for the proper choice of α_O and β_{CO}. In contrast to most experimental tests of molecular orbital theory, the agreement depends rather critically on the choice of these two parameters. The best values found for the parasemiquinone ions are $\alpha_O \cong \alpha_C + 1.2\,\beta_{CC}$ and $\beta_{CO} \cong 1.56\,\beta_{CC}$. The values of $|Q|$ were close to 22.5 gauss. A different set of parameters is needed for the orthosemiquinones. The molecular orbital calculation also fits the experimental splitting constants of the ring protons in the positions meta and para to the methyl group of the tolusemiquinone ion, but there is a large discrepancy at the position ortho to the methyl group. The results of detailed examination of a number of spectra of semiquinone ions are also reported. (Contractor's abstract)

504

Columbia U. [Dept. of Chemistry] New York.

PARAMAGNETIC RESONANCE ABSORPTION, by G. K. Fraenkel. [1960] [7]p. incl. diagrs. refs. [AF 49-(638)520] Unclassified

Published in Technique Org. Chem., v. 1 (pt. 4): 2801-2872, 1960.

The author's contribution to the present series of physical methods of organic chemistry deals with paramagnetic resonance absorption spectroscopy or electron spin resonance, as it is sometimes called. It is a technique for detecting unpaired electrons and for studying the interaction of these electrons with their surroundings. The method is capable of giving very detailed information about crystalline electric fields, electronic energy levels and wave functions, the distribution of unpaired electrons in molecules and complexes, and the mechanisms of thermal relaxation processes. In this section only enough of the theory of paramagnetic resonance is presented to indicate the most important applications and establish those characteristics of paramagnetic spectra which determine the design of paramagnetic spectrometers. Interpretations of the results are confined to applications involving free radicals in condensed phases.

505

Columbia U. Dept. of Chemistry, New York.

NMR SPECTRA OF PROPYL DERIVATIVES, by J. R. Cavanaugh and B. P. Dailey. [1960] [5]p. incl. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)953], Alfred P. Sloan Foundation, and National Science Foundation) Unclassified

Published in Jour. Chem. Phys., v. 34: 1094-1098, Apr. 1961.

A perturbation treatment, carried to third order in the energies and first order in the intensities of the analysis of the propyl group spectra, is presented. Accurate values are given for the coupling constants and chemical shifts of the common propyl derivatives, both for the pure compound and as extrapolated to infinite dilution in carbon tetrachloride. (Contractor's abstract)

506

Columbia U. Dept. of Chemistry, New York.

PROTON CHEMICAL SHIFTS FOR THE ALKYL DERIVATIVES, by J. R. Cavanaugh and B. P. Dailey. [1960] [9]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)953], Alfred P. Sloan Foundation, and National Science Foundation) Unclassified

Published in Jour. Chem. Phys., v. 34: 1099-1107, Apr. 1961.

The chemical shifts of a series of methyl, ethyl, propyl, and isopropyl derivatives have been studied in an effort to determine the distance and angular dependence of any contribution to the chemical shift arising from magnetically anisotropic substituent groups. It was found that electron withdrawal effects play a dominant role in determining the chemical shifts for methyl derivatives. The nearly exactly linear relation of the methyl shifts to electronegativity for the methyl halides seems to rule out any large influence due to magnetic anisotropy. The ethyl shifts were found to be determined by electron withdrawal effects plus a factor which acted equally at the α and β positions. It was found that this factor arises from the carbon-carbon bond. By assigning a chemical shift due to the presence of the C-C bond, which is dependent in size on the substituent attached to the α carbon, the apparently anomalous frequencies observed for the alkyl derivatives can be accounted for. A possible explanation for the C-C bond shift may be regular changes in the paramagnetic term in the Ramsey equation due to changes in the excitation energy denominator when a C-C bond replaces a C-H bond. (Contractor's abstract)

507

Columbia U. Dept. of Electrical Engineering, New York.

RADIO STAR SCINTILLATION AND MULTIPLE SCATTERING IN THE IONOSPHERE, by D. S. Bugnolo. Apr. 1, 1960, 30p. incl. diagrs. refs. (Technical rept. no. T-5/D; rept. no. CU-12-60AF350-EE) (AFOSR-TN-60-451) (AF 49(638)350) AD 237587; PB 148067 Unclassified

Also published in I.R.E. Trans. on Antennas and Propagation, v. AP-9: 89-96, Jan. 1961.

Experimental evidence of radio star scintillation indicates that multiple scattering effects are of importance in the ionosphere. It was therefore of interest to apply the transport equation for the expectation of the photon density function to this problem. The solution of the transport equation was used to predict the mean squared scattering angle and the corresponding size of the ionospheric irregularities as measured on the earth. The particular example discussed in detail was based on a Gallet model for turbulence in the underside of the F layer under nighttime conditions. However, it should be noted that the general theoretical results can be applied to any other model as well.

508

Columbia U. Dept. of Electrical Engineering, New York.

THE SPECTRAL DENSITY OF A MULTIPLY SCATTERED ELECTROMAGNETIC FIELD, by D. S. Bugnolo. Final rept. May 31, 1960, 89p. incl. diagrs. (Rept. no. CU-13-60AF350-EE) (AFOSR-TR-60-10) (AF 49(633)-350) AD 240476; PB 149783 Unclassified

The usual theoretical analyses of the scattering of electromagnetic waves by a random dielectric noise was restricted to a first Born approximation of the integral equation for the scattered field. This is open to question when the length of the path exceeds 1 mean free path in the scattering region. When multiple scattering effects are of importance, the rms magnitude or average power of the field can be found by using the transport equation for the photon distribution in positional velocity space. Doppler shifting of the signal introduces a further complication of interest to the communication engineer. It is therefore necessary to construct a transport equation capable of predicting the power spectral density of the electromagnetic field. This report is concerned with the derivation of a transport equation for the spectral distribution of the photon density function in positional velocity space. The general theory was applied in detail to the case of multiple scattering by random dielectric noise and is independent of any particular model. A method of solution was developed for the case of forward scattering. The results were applied in detail to the earth's troposphere.

509

Columbia U. Dept. of Mathematics, New York.

LOGARITHMIC DIFFERENTIAL FIELDS, AND PRINCIPAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS, by W. Strodt and Harish-Chandra. Final rept. Mar. 17, 1959-May 31, 1960. Nov. 14, 1960, 12p. (AFOSR-TR-60-173) (AF 49(638)644) Unclassified

The research under this contract was divided into three phases: (1) background of the investigation, (2) description of results and methods, and (3) propspective extensions. It is shown that for first order equations if the condition that the coefficients lie in a logarithmic domain is replaced by the more stringent condition that they lie in a Schwarzian-symmetric logarithmic differential field, and if the given neighborhood system $\bar{F}(\alpha, \beta)$ has $\alpha < 0 < \beta$, then conditions that M is simple and the type of P at M is non-exceptional may be omitted, and it can be shown that the existence of a principal solution asymptotically equivalent to M in a suitable $\bar{F}(\gamma, \delta)$, with $\gamma < 0 < \delta$. The proof of this result depends upon (1) various theorems, and (2) the use of a special transformation designed to reduce the multiplicity of the principal monomial.

510

Columbia U. [Dept. of Physics] New York.

OBSERVATIONS OF DISCRETE SOURCES AT 3-CM WAVELENGTH USING A MASER, by L. E. Alsop, J. A. Giordmaine and others. [1958] [6]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)631], Office of Naval Research, and Signal Corps) Unclassified

Presented at 100th meeting of the Amer. Astronom. Soc., Madison, Wis., June 29-July 2, 1958.

Published in Paris Symposium on Radio Astronomy, Cité U. (July 30-Aug. 6, 1958), Stanford, Stanford U. Press, 1959, p. 69-74.

Abstract published in Astronom. Jour., v. 63: 301, Sept. 1958.

For abstract see item no. COU.19:010, Vol. II.

511

Columbia U. Dept. of Physics, New York.

ELECTRON PARAMAGNETIC RESONANCE OF Fe^{3+} IN TiO_2 (RUTILE), by D. L. Carter and A. Okaya. [1960] [6]p. incl. illus. diagrs. tables, refs. (Rept. no. CU-1-60) (AFOSR-TN-60-434) (AF 49(638)631) AD 241320 Unclassified

Also published in Phys. Rev., v. 118: 1485-1490, June 15, 1960.

Paramagnetic resonance has been observed from 2kmc/sec to 110 kmc/sec in Fe^{3+}-doped single crystals of rutile at 78°K, 4.2°K, and 1.4°K. The rather large zero field splittings measured between the three doublets are 43.4± 0.1 kmc/sec and 81.3 ± 0.1 kmc/sec. The derived constants for the spin Hamiltonian $\mathcal{H} = g\beta H \cdot S + D(S_z^2 - 35/12) + E(S_x^2 - S_y^2) + (a/6)(S_x^4 + S_y^4 + S_z^4 - 707/16) + (7/36)F[S_z^4 - (95/14)S_z^2 + 81/16]$, are D = 20.35 ± 0.1 kmc/sec, E = 2.21 ± 0.07 kmc/sec, a = 1.1 ± 0.2 kmc/sec, F = 0.5 ± 0.3 kmc/sec, D = 20.35 ± 0.1 kmc/sec, E = 2.21 ± 0.07 kmc/sec, a = 1.1 ± 0.2 kmc/sec, F = -0.5 ± 0.3 kmc/sec, g = 2.000 ± 0.005. The average line width is 35 mc/sec for 2×10^{19} spins per cm^3, and the average spin-lattice relaxation time T_1 at T = 1.4°K is 4 msec. T_1 still has a very slow inverse temperature dependence even at T = 78°K. An increase in sensitivity over metal walled cavity spectrometers was achieved by using the pieces of Fe-doped rutile as the microwave resonators. (Contractor's abstract)

512

Columbia U. [Dept. of Physics] New York.

THE PARAMAGNETIC RESONANCE SPECTRUM OF Fe^{3+} IN TiO_2 (RUTILE), by A. Okaya, D. Carter, and F. Nash. [1960] [3]p. incl. diagr. [AF 49(638)631] Unclassified

Published in Quantum Electronics, A Symposium, Highview, N. Y. (Sept. 14-16, 1959), N. Y., Columbia U. Press, 1960, p. 389-391.

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 73, Jan 27, 1960. (Title varies)

The electron spin resonance of the $^6S_{5/2}$, $3d^5$ ground state of Fe^{3+} in TiO_2 (Rutile) has been investigated experimentally. The local crystalline field is orthorhombic. The spectrum has been observed from 2 kmc to 120 kmc by a simple video type spectrometer using dielectric microwave resonators. The zero field splittings directly measured are 43.3 ± 0.1 kmc; Ms = 3/2 → 1/2, 81.3 ± 0.1 kmc; Ms = 5/2 → 3/2. The spectrum has been well explained by the constants:

D = + 20.35 ± 0.2 kmc	E = + 2.14 ± 0.06 kmc
a = + 0.8 ± 0.4 kmc	g = 2.00 ± 0.02 kmc

Ti at 1.4°K was about 4 msec at X-band frequencies and less than 1 msec at K band. The saturation of 10^{19} spins was observed at 78°K, X-band frequency with only 0.1 mev power input. This was caused by the high Q and high dielectric constant of the dielectric resonator. The line breadth varies between 3.5 to 15 gauss at X band depending upon the transition.

513

Columbia U. Dept. of Physics, New York.

THE RUTILE MICROWAVE RESONATOR, by A. Okaya. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)631], Office of Naval Research, and Signal Corps) Unclassified

Published in Proc. Inst. Radio Engineers, v. 48: 1921, Nov. 1960.

Single and polycrystalline rutile have microwave reflections at the boundary surfaces. A piece of rutile can replace a metal walled cavity because it acts like a microwave resonator. The relations between the dielectric constant, ϵ', the dimensions, and the resonant frequency were calculated and measurements on the resonant frequency were used to calculate ϵ'. It was found that ϵ' increases about 30% as the temperature is lowered from 300°K to 4.2°K. At the latter fixed temperature the resonant frequency of the rutile was quite constant. A typical Q_0 value (the unloaded Q) for the lowest mode at an X-band frequency was 9000 at room temperature. The polycrystalline rutile resonators had Q's of the order of half those of the single crystals. A rutile resonator was also used to observe paramagnetic resonance of powder sample of DPPH which surrounded the crystal in a thin layer.

514

Columbia U. [Dept. of Physics] New York.

ELECTROMAGNETIC FORM FACTORS OF THE NUCLEON, by F. J. Ernst, R. G. Sachs, and K. C. Wali. [1960] [10]p. incl. diagrs. refs. (AFOSR-TN-60-1160) (In cooperation with Wisconsin U., Madison) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)689] and Atomic Energy Commission) Unclassified

Also published in Phys. Rev., v. 119: 1105-1114, Aug. 1, 1960.

The physical interpretation of the electromagnetic form factors is discussed with special reference to the gauge invariance of particular theories. A distinction is made between the condition that the one nucleon matrix element satisfy the equation of continuity ("weak gauge invariance") and the stronger condition imposed by the generalized Ward identity ("strong gauge invariance"). The former is shown to be a consequence of covariance under the improper Lorentz transformations, and hence it has no new content concerning the functional behavior of the form factors. The latter implies restrictions on the current operator which may have an important effect on the results of calculations of form factors. In connection with the physical interpretation, it is noted

that the moments of the charge and current distribution are determined by $F_{ch} = F_1 - (q^2/2M)F_2$ and $F_{mag} = (1/2M)F_1 + F_2$. Specifically the second moment of the charge distribution, $-6F'_{ch}(0)$, is found in the case of the neutron, to be directly measured by the neutron-electron interaction without the intervening subtraction of the Foldy term. These matters are investigated in detail by means of a specific model of the nucleon which is a covariant generalization of the fixed source static model having the property that it gives results identical with the static model in the limit $M \to \infty$. It is found that strong gauge invariance requires the addition of line currents which make significant contributions to the form factors in general and, in particular, to the proton charge radius even in the static approximation. This suggests that as a consequence of strong gauge invariance, important contributions to the charge radius must arise in any theory from intermediate states of large mass. The model also provides a means of consistently calculating recoil corrections to the static model. They are found to be large. (Contractor's abstract)

515

Columbia U. Dept. of Sociology, New York.

EFFECT OF THE U-2 INCIDENT, by J. Nehnevajsa and A. S. Frances. [Oct. 10, 1960] 40p. incl. tables. (AFOSR-TN-60-1357a) (AF 49(638)743) AD 251734 Unclassified

The U-2 incident was highly salient for the respondents directly involved in this research. The incident's effect, among others to be further studied, was to modify the perception of the existing level of international tensions, and to modify the anticipations of future tensions as well as ideas about past tensions. Yet, it does not seem to have been viewed as a permanent type of change in the tone of international relations. While post-U-2 respondents do expect the tensions in the future to be higher than do pre-U-2 respondents, a leveling off process seems to be seen. (Contractor's abstract)

516

Columbia U. Dept. of Sociology, New York.

FURTHER ANALYSIS OF THE U-2 INCIDENT: EFFECTS OF AN EVENT, by J. Nehnevajsa. Oct. 10, 1960, 35p. incl. tables. (AFOSR-TN-60-1357b) (AF 49(638)743) AD 251735 Unclassified

Fourteen basic hypotheses are formulated about the impact of the U-2 incident, an example of an internationally relevant event, upon salient variables of this research. The variables explicitly considered include: (1) assessment of tension level; (2) probabilities of various outcomes with respect to 1965; (3) desirabilities of various outcomes; (4) personal sense of efficacy; (5) attributed efficacy to one's country; and (6) final outcome of the Cold War. In every instance, the hypotheses are strongly supported by the data. The findings are analyzed and discussed. (Contractor's abstract)

517

Columbia U. Dept. of Sociology, New York.

DEVELOPMENT OF MAJOR STUDY INSTRUMENT, by J. Nehnevajsa. Apr. 15, 1960 [67]p. incl. tables. (AFOSR-TN-60-1358) (AF 49(638)743) AD 251733 Unclassified

Perceptions by selected respondents of the past, present and future levels of tensions were analyzed. A pilot exploration (Pretest) was made using as respondents certain groups of foreign students currently residing in the United States. A panel inquiry was then conducted among decision-makers (as members of lower legislative bodies) and University students (as prospective influentials) in two countries, Brazil and Finland. This second research phase will be referred to as the Study. This report deals solely with the methodological aspects of the Pretest. Its aim is to show how the Study instruments differ from the Pretest instruments as a function of the Pretest experiences. (Contractor's abstract)

518

Columbia U. Dept. of Sociology, New York.

ANTICIPATORY ANALYSIS OF IDEOLOGICAL CONFLICT, by J. Nehnevajsa. July 31, 1960, 10p. incl. tables. (AFOSR-TN-60-1359a) (AF 49(638)743) AD 251730 Unclassified

A method was explored for the study of ideological conflicts between any two, or among several, sociological referents. These referents may be individuals, collectivities or social systems. Proceding on the premise that in order to understand the present, it is necessary to understand the future, it is felt that it should be possible to identify alternative states of the total system for some specific futures. After these alternative futures are identified, their acceptability to two or more referents is measured to determine ideological conflict. If acceptabilities of futures change as a function of the temporal date involved in the set of alternatives, this indicates instabilities in the degree of conflict and the directions of the desirability changes points to the nature of changes in the conflict level itself. A pretest study was conducted with students from different countries to analyze their perception of the conflict between the United States and the Soviet Union, the United States and the respondent's country, and the Soviet Union and the respondent's country. Results of the study and implications for future research are discussed. (Contractor's abstract)

519

Columbia U. Dept. of Sociology, New York.

EXPLORATIONS IN IDEOLOGICAL CONFLICT, by J. Nehnevajsa. Oct. 10, 1960, 69p. incl. tables. (AFOSR-TN-60-1359a) (AF 49(638)743) AD 251731
Unclassified

A new theoretical approach to the analysis of ideological conflicts is presented. The analysis was performed in relation to outcomes which are, in turn, specifications of future states of the total system. As such, these outcomes include the consideration of all goals and all moves of all components – hence involving all antagonists. Variable acceptability along the desirability dimension measures the ideology of a particular referent; and the degree of disagreement in such acceptability vectors measures the ideological conflict between any 2 referents viewed simultaneously. It was felt that an appropriate index of ideological conflict is given by the complement of some relevant correlation coefficient over the set of outcomes, each of which is characterized by desirability. Using data from the Project Pretest - in which Italian, Canadian, Chinese and Iranian University students currently in the United States were questioned along with a few American University students - several hypotheses were developed and tested.

520

Columbia U. Dept. of Sociology, New York.

STUDY INSTRUMENTS: SECOND WAVE BRAZIL AND FINLAND, by J. Nehnevajsa and A. [S.] Frances. Oct. 15, 1960 [69]p. incl. diagrs. tables. (AFOSR-TN-60-1360) (AF 49(638)743) Unclassified

The revisions of a major study instrument for the purposes of second wave interviewing in Finland and Brazil is presented. The previous report developed the instrument in relation to the Pretest experiences with initial questionnaires. The reinterviewing will permit an assessment to be made on the impact of events which have occurred between the first wave interview (Apr.-May 1960) and the second wave interviews (anticipated termination Jan. 15, 1961). The inclusion of a new sample of respondents will analytically provide some minimal controls in that it will be able to determine if some empirical changes occurring are a function of reinterviewing itself or are actual changes in perception of world affairs.

521

Columbia U. Dept. of Sociology, New York.

ELEMENTS OF PROJECT THEORY FROM CONCEPTS TO DESIGN, by J. Nehnevajsa. Oct. 20, 1960, 22p. (AFOSR-TN-60-1361) (AF 49(638)743) AD 251736
Unclassified

Some of the theoretical problems involved in the research being undertaken, and the methodology developed to cope with the substantive issues raised are analyzed. The ultimate aims are: (1) to develop a theoretical system which helps to account for certain forms of behavior - a type of middle-range theory of behavior; and (2) to develop adequate methods for testing out the theory at least to a large extent.

522

Columbia U. Dept. of Sociology, New York.

SOME COLD WAR EFFECTS OF SPACE ACTIVITIES, by J. Nehnevajsa. Dec. 20, 1960, 15p. incl. tables. (AFOSR-TN-60-1429) (AF 49(638)743) AD 251886; PB 154994 Unclassified

Some preliminary results from an on-going research study of international political behavior are discussed, and the types of further data expected to be obtained from it which have bearing on the problem are specified. The place of the particular information in the context of broader data requirements is indicated to permit an analysis and understanding of the interactions between the Cold War and unfolding space activities. (Contractor's abstract)

523

Columbia U. [Electronics Research Labs.] New York.

AN ADAPTIVE SYSTEM USING PERIODIC ESTIMATION OF THE PULSE TRANSFER FUNCTION, by S. Bigelow and H. Ruge. June 30, 1960, 31p. incl. diagrs. tables. (Technical rept. T-40/B; rept. no. CU-63-60AF677-EE) (AFOSR-TN-60-688) (AF 18(600)677) AD 243718
Unclassified

Schemes for the practical realization of adaptive control are considered. The behavior of such schemes is investigated by studying in detail a particular plant-adaptive control system. A general purpose digital computer was used for experimental simulation. The system considered may be described in terms of two basic blocks, the plant and the control computer. The control computer is a digital device, and as such its inputs and outputs are inherently sampled signals. The plant or process to be controlled is assumed to be a continuous, low-pass, linear but time-varying dynamic system, and to include a zero-order hold which converts the sampled input to a piecewise-constant signal. The dynamic behavior of such a system may be characterized by a pulse transfer function with time-varying coefficients. The control computer serves 2 basic purposes: (1) from samples of the plant input and output it computes periodically a statistical estimate of the plant pulse transfer function; and (2) using the current estimate of the dynamic behavior of the plant and measurements of system input (setpoint) and output, the plant input is computed in accordance with a suitable overall performance criterion. (Contractor's abstract)

524

Columbia U. Inst. of Flight Structures, New York.

ON VARIATIONAL PRINCIPLES IN THERMOELASTICITY AND HEAT CONDUCTION, by G. Hermann. Apr. 1960 [18]p. (Technical note no. 4; rept. no. CU-10-60AF430-CE) (AFOSR-TN-60-415) (AF 49(638)430) AD 237902 Unclaseified

Also published in Quart. Appl. Math., v. 21: 151-155, July 1963.

The variational principles for displacements, for stresses and for both displacements and stresees in isothermal elasticity are extended to the coupled proceeses of thermoelasticity and heat conduction in a 3-dimensional, anisotropic body. The character of theee principles is examined and it is established that in a stable system one is concerned with a minimum, a maximum and a stationary value problem, respectively. (Contractor'e abetract)

524A

Columbia U. Inst. of Flight Structures, New York.

DYNAMIC BEHAVIOR OF CYLINDRICAL SHELLS UNDER INITIAL STRESS, by G. Hermann and A. E. Armenakas. Apr. 1960 [34]p. incl. diagrs. (Technical note no. 5; rept. no. CU-11-60AF430-CE) (AFOSR-TN-60-425) (AF 49(638)430) AD 237901 Unclaseified

Also published in Proc. Fourth U. S. Nat'l. Cong. of Appl. Mech., California U., Berkeley (June 18-21, 1962), New York, Amer. Soc. Mech. Engineers, 1962, p. 203-213.

Baeed upon the non-linear 3-dimensional theory of elasticity, several linearized theoriee of motion of cylindrical ehells, subjected to a general state of initial stress, are established. These theoriee may be applied in stuoying a variety of probleme, as for example, in studying the effect of initial streseee on the frequenciee of free vibrations and on the velocitiee of wave propagation. Furthermore, they may be employed in the determination of buckling loads, analytically, and possibly experimentally by means of non-destructive frequency measurements.

525

Columbia U. [School of Engineering] New York.

MICROCRACKS IN MILD STEEL, by D. N. Beshers, M. Ohring, and W. F. Schnabel. June 1960, 14p. incl. illue. diagr. (AFOSR-TN-60-977) (AF 49(638)408) AD 247554 Unclaesified

The origin and nature of microcracks in various iron compositions and eteels were investigated. Polycrystalline eamplee of pure iron and mild steel in the form of polished sheet tensile specimens about 0.040 in. thick were pulled at liquid N temperaturee, etched with nital to bring out the grain boundariee, and then electro-etched. The epecimens were examined under a microscope for cracks which were contained entirely within 1 grain. Moet of the cracks were observed in the 1020 steel specimens; eome were obeerved in 1010 eteel but none were eeen in Armco iron epecimens. All but 4 of the 19 eingle grain cracks obeerved eupported the hypothesie that the firet crack is a (100) cleavage crack. The growth of microcracks appeared to be the result of eome type of imperfection, such ae a cavity dislocation which can gnaw when some condition involving the applied etrees is fulfilled, but then becomes a microcrack and may be etopped. Studies indicated that microcracks tend to lie perpendicular to the tensile and form in, and propagate through grains which are larger than average. Microcrack propagation into a new grain is more likely when the new grain ie favorably oriented; the microcracks can be etopped ehort of grain boundaries.

526

Combustion Inst., Pittsburgh, Pa.

EIGHTH SYMPOSIUM (INTERNATIONAL) ON COMBUSTION, California Inst. of Tech., Pasadena (Aug. 28-Sept. 3, 1960), Baltimore, Williams and Wilkins Co., 1962, 1164p. incl. illue. diagrs. tablee, refs. (AFOSR-TR-60-127) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)869, Office of Naval Research, and Office of Ordnance Reeearch) Unclaseified

This eymposium was divided into eeveral areas of intereet in order to accommodate the large scope of eubject matter with which it dealt. Theee included chemical kinetice; ions in flames; combuetion spectroecopy; shock wavee and relaxation phenomena; nozzle flow with chemical reactions; laminar flamee; turbulent flames; detonations and exploeions; ammonium perchlorate and propellants; eroeive burning; formation, combustion, exploeion and detonation of eolids; unetable combuetion in solid fuele; flame holding; and liquid propellant engines. One of the highlights of the meeting was a round table diecuseion among eeveral dietinguished scientiets who debated the following questions, among othere: (1) What type of areas of reeearch ehould be pursued in order to accelerate propuleion development, in general, and the construction of very large booeter rockets, in particular? (2) Will the development of advanced propuleion (e.g., nuclear propulsion, ion propulsion) lead to early obsoleecence of combuetion research insofar as propulsion development is concerned? Concerning the latter question there was unanimoue agreement that preeent day research hae not been in vain.

527

Combustion Inst., Pittsburgh, Pa.

EIGHTH SYMPOSIUM (INTERNATIONAL) ON

COMBUSTION: ABSTRACTS OF PAPERS, California Inst. of Tech., Pasadena (Aug. 28-Sept. 3, 1960). [1960] 176p. incl. illus. diagrs. tables, refs. (AFOSR-TR-60-127a) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)869, Office of Naval Research, and Office of Ordnance Research)
Unclassified

This report contains abstracts of the papers published in total by the Combustion Inst. of Pittsburgh. The purpose, unique approaches, and results of all research reported on at the symposium are presented, but for a more detailed analysis of background, procedures, comparisons, and future experiments the reader is referred to the complete publication, reviewed in this volume as AFOSR-TR-60-127 (item no. 526).

Committee on Mathematical Biology, Chicago, Ill.
see Chicago U. Committee on Mathematical Biology, Ill.

528

Compagnie de Recherches et d'Etudes Aeronautiques, Paris (France).

CONTROL OF CIRCULATION AROUND A CIRCULAR CYLINDER, by J. Brocard. May 20, 1960 [28]p. incl. illus. diagrs. table. (AFOSR-TN-60-1015) (AF 61(052)-333) AD 242537
Unclassified

A method of obtaining quantitative as well as qualitative results in the water tank is presented. The method allows a flexible and economical technique for the study of the various parameters concerning the sucked areas, the intensity of suction, the nature of the sucked areas, etc., which may influence the values of C_D and C_L, the drag and lift coefficients. The results show that the maximum C_L correspond to a suction of 72°. It decreases rapidly as incidence increases. For a suction over 180°, the maximum C_L is decreased by 9%. Since the power necessary to obtain a suction with constant C_q (suction coefficient) is as a first approximation, proportional to the pressure loss, the configuration $\theta = 180°$ is the most advantageous.

529

Compagnie de Recherches et d'Etudes Aeronautiques, Paris (France).

CONTROL OF CIRCULATION AROUND A CIRCULAR CYLINDER, by J. Brocard. Final technical rept. Oct. 1, 1960 [45]p. incl. illus. diagrs. tables. (AFOSR-TR-60-181) (AF 61(052)333) AD 252815; PB 155290
Unclassified

Research designed to obtain data on the control of the boundary layer of a cylinder, the longitudinal axes of which are perpendicular to the wind is presented. The general conclusions of the report are as follows: (1) The method of sucking the boundary layer on the circular cylinder enabled maximum values of C_L (lift coefficient) to be obtained ranging from 2.9 to 3.2 with a suction coefficient $C_q = 0.17$. The boundary layer was sucked over an angular area of 180°. (2) The adjunction of a radial flap, appropriately placed on the contour of the cylinder improves the lift-drag ratio and slightly increases the value of the maximum C_L. (3) These first experiments are encouraging and show that it is advisable to resume the study by means of the same experimental method which proved to be both simple and economical.

530

Connecticut U. [Dept. of Mathematics, Storrs].

ON ORTHONORMAL SERIES AND DENSITY OF INTEGERS, by R. P. Gosselin. May 1960, 17p. (AFOSR-TN-60-555) (AF 49(638)608) AD 238207; PB 148402
Unclassified

Also published in Duke Math. Jour., v. 28: 133-142, Mar. 1961.

The convergence implications of hypotheses on the coefficient sequence orthonormal series of the type $\Sigma_{n \geq 1} (\log n)^b |a_n|^2 < \infty$, $0 \leq b < 2$ are considered. The results are stated in terms of the almost everywhere convergence of subsequences of the full sequence of partial sums whose indices satisfy specified density conditions. (Contractor's abstract)

531

Connecticut U. [Dept. of Mathematics] Storrs.

ON THE INTERPOLATION OF L^p FUNCTIONS BY JACKSON POLYNOMIALS, by R. P. Gosselin. Sept. 1960, 10p. (AFOSR-TN-60-1066) (AF 49(638)608) AD 244666
Unclassified

Also published in Illinois Jour. Math., v. 5: 467-473, Sept. 1961.

The precise order of the upper limit of the sequence of Jackson polynomials interpolating an L^p function at the usual points of interpolation translated by an arbitrary real is determined. The result is generalized to certain sequences of operators, and the generalized result is applied to other sequences of functions. (Contractor's abstract)

532

Copenhagen U. Dept. of Chemistry (Denmark).

INFRARED ABSORPTION SPECTRA OF BENZONITRILE AND ITS MONODEUTERATED DERIVATIVES. TENTATIVE ASSIGNMENT OF FUNDAMENTALS, by B. Bak and J. T. Nielsen. [1960] [3]p. incl. diagr. tables. (AFOSR-TN-60-128) [AF 61(052)73] AD 244376 Unclassified

Also published in Zeitschr. Elektrochem., v. 64: 560-562, 1960.

The infrared spectra of benzonitrile and its 3 monodeuterated derivatives were recorded. By use of the striking similarity between these spectra and previously published spectra of corresponding isotopic pyridines, and by taking advantage of published Raman data and data from the far infrared obtained by Barchewitz (Jour. Phys. (Paris), v. 10: 143, 1939), a tentative assignment of 28 of the 33 fundamentals is given. An analysis of the 5 hydrogen valence-vibration is omitted. (Contractor's abstract)

533

Copenhagen U. [Dept. of Chemistry] (Denmark).

MOLECULAR STRUCTURE CORRELATIONS, by B. Bak and L. Hansen-Nygaard. [1960] [6]p. incl. diagr. table, refs. (AFOSR-TN-60-129) [AF 61(052)73] AD 252305 Unclassified

Also published in Jour. Chem. Phys., v. 33: 418-423, Aug. 1960.

The molecular structure of methane, ethane, ethylene, acetylene, ethyl fluoride, benzene, butadiene, allene, butatriene, propylene, cyclooctatetraene, methyl acetylene, diacetylene, methyl cyanide, methyl isocyanide, vinyl cyanide, carbon dioxide, formaldehyde, acetaldehyde, propynal, acrolein, formic acid, methyl formate, formamide, and acetyl cyanide (25 molecules) have been correlated by means of a set of empirical parameters, the physical meaning of which is discussed in part. (Contractor's abstract)

534

Copenhagen U. [Dept. of Chemistry] (Denmark).

MICROWAVE DETERMINATION OF THE STRUCTURE OF ETHYL FLUORIDE, by B. Bak, S. Detoni and others. [1959] [8]p. incl. diagrs. tables, refs. (AFOSR-TN-60-130) (AF 61(052)73) AD 252299 Unclassified

Also published in Spectrochim. Acta., v. 16: 376-383, 1960.

Eleven isotopic ethyl fluorides were prepared and investigated by the microwave method. Since both carbon atoms and all hydrogens were successively substituted by C^{13} and deuterium, the resulting structural determination is as complete as feasible at the moment. The geometrical parameters found are C-C = 1.533A; C-F = 1.379A; C(1)-H = 1.094A; C(2)-H(3) = 1.092A; C(2)-H(5) = 1.098A; C-C-F = 109°27'; C(2)-C(1)-H = 111°17'; C(1)-C(2)-H(3) = 110°06'; C(1)-C(2)-H(5) = 110°10'. The staggered conformation was unambiguously proved. In all cases where rotational isomerism was to be expected the correct number of isomers was found and the microwave spectrum of each rotational species was analyzed. (Contractor's abstract)

535

Copenhagen U. [Dept. of Chemistry] (Denmark).

PREPARATION OF CARBON ISOTOPICALLY LABELLED THIOPHENES, by B. Bak, J. Christiansen, and J. T. Nielsen. [1960] [2]p. (AFOSR-TN-60-1349) (AF 61(052)73) AD 456582 Unclassified

Also published in Acta Chem. Scand., v. 14: 1865-1866, 1960.

Methods of preparing 2-^{13}C- amd 3-^{13}C-thiophene as a pre-requisite for a complete determination of the structure of thiophene by microwave technique are presented. These methods were adopted after repeated experiments with non-labelled compounds, and the purity of the resulting isotopically labelled samples was satisfactorily checked by controlling the vapor-pressure and by recording the infra-red absorption curves. No lines from impurities were observed in the microwave region, but the infra-red spectra showed the presence of about 5% CS_2.

536

Copenhagen U. [Dept. of Chemistry] (Denmark).

THE STRUCTURE OF THIOPHENE, by B. Bak, D. Christensen and others. [1960] [6]p. incl. diagr. tables. (AFOSR-TN-60-1350) (AF 61(052)73) AD 611511 Unclassified

Also published in Jour. Molec. Spectros., v. 7: 58-63, July 1961.

In the improved thiophene model now given, the carbon - carbon distances in thiophene are closer to the benzenoid carbon - carbon distance than in an earlier investigation, and rendering thiophene more aromatic than might be seen by the earlier model. Within limits of error the lengths of the C(2)C(3) and the C(3)C(4) bonds are symmetrically displaced with respect to the carbon - carbon bond length in benzene. The C(3)C(4) bond length is such that it is reasonable to assume that the mobile charge of the 2 bonds is the same, viz., 0.67 e. The measured bond length of the C, S bond in thiophene is almost midway between a pure single bond and a pure double bond. The total mobile charge is 4.93 e in

harmony with the fact that carbon and sulfur have the same electronegativity. Taken together with earlier published data an unambiguous calculation of the ('r_s'-) structure is given, the parameters being: C-S = 1.714A; C=C = 1.370A; C-C = 1.423A; C(2)-H(2) = 1.078A; C(3)-H(3) = 1.081A; (angles) C(5)-S-C(2) = 92°10'; S-C(2)-C(3) = 111°28'; C(2)-C(3)-C(4) = 112°27'; S-C(2)-H(2) = 119°51'; C(4)-C(3)-H(3) = 124°16'.

537

Copenhagen U. Inst. of Neurophysiology (Denmark).

CORRELATION OF ELECTROENCEPHALOGRAPHIC FINDINGS WITH CRASH RATE OF MILITARY JET PILOTS, by M. Lennox-Buchthal, F. Buchthal, and P. Rosenfalck. June 1960 [7]p. incl. tables. (AFOSR-TN-60-1072) (AF 61(052)1194) AD 253774 Unclassified

Presented at meeting of the Aero Medical Association, Denver, Colo., May 6-8, 1957.

Also published in Epilepsia, v. 1: 366-372, 1960.

Electroencephalograms were obtained on 576 candidates who were admitted to the Royal Danish Air Force for jet pilot training in 1951 through 1955. There was a correlation with the EEG in that the crash rate was 3 times higher in pilots with marked and paroxysmal EEG abnormalities than in those with normal or slightly abnormal EEGs ($P = 0.05$). The correlation was somewhat closer when only those crashes were considered which were attributed to pilot error. EEGs rendered abnormal only during photic stimulation were as significant as those with marked or paroxysmal abnormalities at rest or during hyperventilation. As a consequence of these findings an EEG is now obtained for all applicants for jet pilot training in the Royal Danish Air Force and those with marked or paroxysmal abnormalities at rest, during hyperventilation or during photic stimulation are rejected without regard to the clinical findings. There was no correlation between the EEG and the dismissal rate of trainees, most of whom were dismissed for inaptitude for flying.

538

Cork U. Coll. (Ireland).

ELASTIC BEAM THEORY FOR THE ELECTRONIC COMPUTER - A RECURRENCE APPROACH, by P. M. Quinlan. June 1960, 40p. incl. diagrs. tables, refs. (Technical note no. 9) (AFOSR-TN-60-936) (AF 61-(514)1163) AD 242326; PB 150350 Unclassified

A new comprehensive approach to elastic beam theory is presented based on the use of generalized step functions. The analysis is divided into 2 parts, the first dealing with uniform beams and the second with non-uniform beams. Uniform beam on continuous supports, whether rigid or elastic, is solved using a new formulation of the 3-moment equation in conjunction with a shear-recurrence formula-called the 3-supports equation. A worked example of a beam continuous over 8 elastic supports shows the ease with which this problem is reduced to the solution of a set of simultaneous linear equations, or to a computer problem. An alternative solution for continuous uniform beams on elastic supports is given using generalized step-functions. A similar approach gives a solution to the problems of a loaded uniform beam, subject to end thrust, and continuous over a number of elastic supports. Part 2, dealing with non-uniform beams, is based entirely on recurrent formulae obtained from generalized step-function approximations to the deflection and slope equations by differencing. Solutions are obtained for all loading conditions, including concentrated moments - currently of much interest in prestressed concrete arising from the effects of the prestressing cables - and end thrust, or end tension. In all cases the solution is reduced to a number of simultaneous equations and is especially geared to the coming decade, when the solution of such equations on the electronic computer should be regular office routine. It appears that the new recurrence methods developed for non-uniform beams may also prove to be the most expeditious way of dealing with uniform beams. (Contractor's abstract)

539

Cork U. Coll. (Ireland).

NON-LINEAR BENDING OF AN ANNULAR PLATE, by V. G. Hart. Dec. 1960, 27p. incl. diagrs. tables, refs. (Technical note no. 10) (AFOSR-449) (AF 61(514)1163) AD 254352; PB 155692 Unclassified

The bending of an annular or ring-shaped plate under the action of edge forces transverse to its initial plane is computed by a method involving the motion of boundary layers, or narrow strips adjacent to the edges of the plate inside which the bending stresses are of primary importance. The plate is considered to be very thin, the width of the ring to be unrestricted, and the problem to have radial symmetry. Non-linear differential equations were integrated numerically by a digital computer in the case of the zero order solution for the boundary layers. In the interior of the plate, the solution was obtained in analytic form in zero order which was combined with the solutions corresponding to each boundary layer to give an approximate solution defined throughout the plate. From this solution the deflection of the plate, the radial bending moment, the slope, and the radial and circumferential membrane stresses were calculated.

540

Cork U. Coll. (Ireland).

THE λ, μ METHOD FOR RECTANGULAR AND SKEW PLATES, by P. M. Quinlan. Dec. 1960, 1v. incl. diagrs. refs. (Technical rept. no. 11) (AFOSR-450) (AF 61-(514)1163) AD 254446 Unclassified

A new method is presented capable of solving plate problems for rectangular plates under all systems of transverse loadings. Extensive use is made of the 2-step functions λ and μ which change from +1 to -1 at certain points, to enable all cases to be represented by a single formula. The calculus of 2-step functions is fully developed leading to easily applied operators for expressing deflections, moments, shears, etc., in terms of the functions U_i and V_j; i = 1,2,3,4 and j = 1,2. Three worked examples are included. The last section treats problems for a skew plate. The solution is shown to depend on relatively simple functions, called the root functions, and the 2-step constants λ, μ, and λ_{ij}. Expressions are obtained for the particular integral for all the above loadings, and a system of simultaneous equations is obtained for the complementary function required in skew plate problems for all the usual boundary conditions. (Contractor's abstract)

541

Cork U. Coll. (Ireland).

PRESSURE-TIME CURVE EXTRAPOLATION IN METEOROLOGICAL FORECASTING, by G. V. Kelly. Dec. 1960, 36p. incl. tables. (Technical note no. 12) (AFOSR-451) (AF 61(514)1163) AD 254353 Unclassified

The present paper is an effort to develop mathematical methods for extrapolating the pressure-time curve in meteorology for short-range forecasting. In section 1 the step-function of curve-fitting developed recently by Quinlan (item no. 402, Vol. III) is extended to extrapolation and the necessary calculus developed together with the moving windows calculation scheme for use in the evaluation of recurrence formulae. Section 2 is an effort to fit a curve to the pressure data, using step-function techniques, with greater continuity than in section 1. If a curve of higher continuity than in section 1 is to be fitted, then for continuity of degree two second derivatives of the pressure must be introduced. Likewise for third degree continuity, both the second and third derivatives must be introduced, and the practicality of these is dubious. Section 3 is a study of extrapolation using Taylor series to extrapolate beyond the last observation. The main difficulty encountered was how to obtain reliable estimates for the pressure derivatives involved. Resort was had to various end-point formulae for the calculation of derivatives, as information beyond the last observation is obviously not available for calculation of derivatives, and various methods of smoothing were used. In general, the results failed to reveal any practical extrapolation method. In the final section an effort was made to fit various polynomials to the given pressure-time curve using Chebychev Polynomials. Very close fits were obtained, but when the resulting polynomial curves were extrapolated the Chebychev Polynomials increased so rapidly in value that extrapolation for a half-hour was scarcely possible. It is concluded that none of the methods investigated is likely to be as good as a trained forecaster.

542

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

SIMILITUDE OF HYPERSONIC REAL-GAS FLOWS OVER SLENDER BODIES WITH BLUNTED NOSES, by H. K. Cheng. [1959] [11]p. incl. diagrs. refs. (In cooperation with Bell Aircraft Corp., Buffalo, N. Y.; AF 18-(600)1607) (AF 18(603)10) Unclassified

Published in Jour. Aero/Space Sci., v. 26: 575-585, Sept. 1959.

On the basis of the hypersonic small-perturbation theory, the laws of similitude for hypersonic inviscid flow fields over thin or slender bodies are examined, and the restrictions to ideal gases with constant specific heats and to bodies with pointed noses are removed. Only steady plane or axisymmetric flows are considered. Inspection of the governing system of equations shows that a similitude law exists for flow fields, under local thermal equilibrium, having the same free-stream atmosphere. For flows of ideal gas with constant specific heats, the requirement of the same free-stream atmosphere-i.e., the same composition pressure and density - can be replaced by the requirement of the same ratio of specific heats, γ. For flows over blunted wedges or cones, special laws of similitude can be obtained. Application of the similarity rules is examined for the case of hypersonic flows of an ideal gas with $\gamma = 1.40$ over flat plates with blunt leading edges, and for the case of equilibrium air flows over wedges. The possibility of simulating nonequilibrium flows over slender or thin bodies is also pointed out. (Contractor's abstract)

543

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

HEAT TRANSFER TO SHARP AND BLUNT YAWED PLATES IN HYPERSONIC AIRFLOW, by J. G. Hall and T. C. Gollan. Sept. 1960 [8]p. incl. diagrs. (Rept. no. AD-1052-A-11) (AFOSR-TN-60-938) (AF 18(603)-10) AD 245531; PB 152947 Unclassified

Also published in Jour. Aero/Space Sci., v. 28: 345-346, Apr. 1961.

Experimental results for heat-transfer distributions over sharp and blunt plates at yaw with zero angle of attack are reported. Heat-transfer tests were conducted in the C.A.L. 11- x 15-in. shock tunnel with a model yawed at 45°. Tests were also made to obtain comparable data for zero angle of yaw. Nominal values of airflow Mach number, M, and stagnation temperature, T_0, were 11.4 and 1950°K, respectively. The ratio of wall temperature, T_w, to stagnation temperature was about 0.15 (T_w = 300°K). A nominal stagnation pressure of 1150 psi, and leading-edge thicknesses, t, of 0.0005 and 0.191 in. provided leading-edge Reynolds numbers, Re_t, of approximately 10 and 4000, respectively. Typical

results for measured heat-transfer rate versus distance measured normal to the plate leading edge are shown for zero yaw and 45° yaw with t = 0.191 in., and Re_t = 4000. The distribution and magnitude of heat transfer rate characterize a laminar boundary layer. (Contractor's abstract)

544

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

SUMMARY OF SHOCK TUNNEL DEVELOPMENT AND APPLICATION TO HYPERSONIC RESEARCH, by A. Hertzberg, C. F. Wittliff, and J. G. Hall. July 1961 [120]p. incl. illus. diagrs. tables, refs. (Rept. no. AD-1052-A-12) (AFOSR-TR-60-139) (AF 18(603)10) AD 260731 Unclassified

This report reviews the development of the shock tunnel, discusses its present capabilities, and outlines future prospects. The ability of the shock tunnel to produce air flows at stagnation temperatures and pressures associated with hypersonic flight has been well established. The "tailored-interface" technique has significantly increased the available testing time in a shock tunnel. This testing-time extension, plus the development of effective rapid-response instrumentation, now permits the accurate measurement of pressures, forces, and heat-transfer rates. The hypersonic shock tunnel in its present form is capable of duplicating re-entry flight conditions for various hypersonic vehicles over an important area of the re-entry flight corridor. Its success has encouraged studies which indicate that significant further developments of a shock tunnel are possible. In particular, exploratory experiments have demonstrated the usefulness of the shock tunnel for the investigation of hypervelocity rarefied-gas flows associated with the re-entry of manned vehicles. To fully exploit the potential of the shock tunnel for this type research, extremely large size test sections have been shown to be required and feasible, thus making available the advantages of nearly full-scale testing within the laboratory. In addition, anticipated developments in the technique of operation indicate the possibility of extending the range of complete flight duplication so that nearly the entire range of critical flight re-entry can be conveniently studied. (Contractor's abstract, modified)

545

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

SHOCK-TUNNEL STUDIES OF HYPERSONIC, FLAT-PLATE AIRFLOWS, by J. G. Hall and T. C. Golian. Dec. 1960 [73]p. incl. illus. diagrs. tables, refs. (Rept. no. AD-1052-A-10) (AFOSR-TR-60-142) (AF 18(603)10) AD 251084; PB 154712 Unclassified

The effects of boundary-layer displacement and leading-edge bluntness on the inviscid and viscous characteristics of hypersonic airflow over plates were investigated in the shock tunnel for low values of wall-to-stagnation temperature ratio. Studies of surface heat transfer and shock shape were carried out at airflow Mach numbers around 12 in the CAL-AFOSR 11 x 15 in. hypersonic shock tunnel. The range of experimental conditions encompassed the limiting cases of pure bluntness effect and pure viscous interaction effect. A stagnation temperature of 2000°K with a wall-to-stagnation temperature ratio of 0.15 was employed in most of the tests. At zero angle of attack and zero yaw, leading-edge Reynolds numbers ranged from 3 to 15,000 and stream Reynolds number per in. from 1.4×10^4 to 1.8×10^5. Angle of attack effects without yaw and yaw effects without angle of attack were studied at small and large leading-edge Reynolds numbers. Heat-transfer measurements were also made on a sharp plate at stagnation temperatures up to 4000°K. Surface-pressure studies were carried out with a sharp plate at zero angle of attack at Mach numbers of 9, 14.6, and 16.1 in the 24 x 24-in. shock tunnel, and at Mach number 12 in the 11 x 15-in. tunnel. Pressure measurements on a blunt plate were also made at Mach number 12. The wall-to-stagnation temperature ratio for these tests was also about 0.15. The experimental data are correlated in terms of a general viscous similitude extended to include bluntness. Comparison of the experimental data is made usually with the lowest or zero-order approximation (for $\gamma - 1$) of a general bluntness-displacement-angle of attack theory. Over a very wide range of combined bluntness-displacement-angle of attack effects, the heat transfer and schlieren data are quite well correlated by this viscous similitude extended for bluntness. Quantitative agreement with the zero-order theory is generally fair. At a yaw angle of 45° for sharp and blunt plates, the heat transfer is well correlated with zero-yaw results on the basis of the two-dimensional flow similitude. The sharp-plate pressure data are correlated reasonably well by the usual viscous-interaction parameter and show a definite transition from weak to strong interaction. The blunt-plate pressure data agree fairly well with blast-wave predictions but appear low with respect to the corresponding measured heat transfer.

546

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

PROPAGATION OF WEAK DISTURBANCES IN A GAS SUBJECT TO RELAXATION EFFECTS, by F. K. Moore and W. E. Gibson. [1960] [71]p. incl. diagrs. refs. [AF 18(603)19] Unclassified

Presented at Twenty-seventh annual meeting of the Inst. Aeronaut. Sci., Aerodynamics Session, New York, Jan. 26-29, 1959.

Published in Jour. Aero/Space Sci., v. 27: 117-127, Feb. 1960.

A generalized wave equation is derived for sound disturbances in a gas when relaxation effects connected with, for example, molecular vibration or dissociation

are important. Solutions involving discontinuous wave fronts are presented, and it is shown that, under certain assumptions, the complete wave equation reduces to a variant of the telegraph equation. Detailed solutions are presented for disturbance fields produced by a wavy wall in subsonic and supersonic flow. This study is reviewed as a step in the development of a theory of small disturbances of a high-temperature gas, as is found behind the shock of hypersonic flight. (Contractor's abstract)

547

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

HYPERSONIC RESEARCH SUMMARY, by G. J. Fabian. June 1960, 24p. incl. refs. (Rept. no. AD-1118-A-11) (AFOSR-TR-60-58) (AF 18(603)141) AD 238152; PB 148357 Unclassified

The following research areas investigated are reported in summary: wave superheater, chemical nonequilibrium in high-temperature gas flows, radiation probe, sound propagation in an excited or dissociated gas, boundary-layer phenomena in high-temperature flows, molecular interactions at high temperatures.

548

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

VISCOSITY OF DISSOCIATED GASES FROM SHOCK-TUBE HEAT-TRANSFER MEASUREMENTS, by R. S. Hartunian and P. V. Marrone. [1960] [9]p. incl. diagrs. tables, refs. (AFOSR-541) [AF 18(603)141] AD 260435 Unclassified

Also published in Phys. Fluids, v. 4: 535-543, May 1961.

Measurements of the heat transfer from dissociated oxygen to the sidewall of a shock tube have been made over a range of operating conditions using the methods of thin-film thermometry. Numerical solutions of the equilibrium shock-tube wall boundary layer equations for several values of the Lewis number have been obtained. The results show the heat transfer to be very weakly dependent upon the Lewis number. This fact indicates the shock-tube wall boundary layer to be a source for experimental determinations of the viscosity coefficient of dissociated gases. Experimental data obtained in the equilibrium boundary layer regime agree with the theory at the low temperatures, and rise above the theoretical curves at the higher temperatures. This difference between theory and experiment is attributed to the uncertainty in the calculated viscosity coefficient used in the theory. The experiments were then used to determine new values for the viscosity coefficient of high temperature, dissociated oxygen. These values are considerably higher than those predicted theoretically using a Lennard-Jones potential or Sutherland's formula. (Contractor's abstract)

549

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

A GRAPHICAL SOLUTION FOR NORMAL SHOCK WAVES IN REAL GASES, by C. E. Treanor. [1960] [3]p. incl. diagrs. (AF 18(603)141) Unclassified

Published in Jour. Aero/Space Sci., v. 27: 158-160, Feb. 1960.

In this rapid, graphical method of obtaining shock solutions the accuracy is limited only by the accuracy of the graph available for the gas properties. No iterative procedure is involved, and the only machine or slide-rule calculations required are for factors concerning the initial conditions of the gas and the speed of the shock wave. The method can be extended for calculation of conditions behind a reflected shock wave.

550

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

SHOCK-TUBE MEASUREMENTS OF TRANSITION PROBABILITIES FOR OXYGEN AND NITRIC OXIDE, by C. E. Treanor, W. H. Wurster and others. Apr. 1960, 53p. incl. diagrs. tables, refs. (Rept. no. QM-1209-A-2) (AFOSR-TR-60-59) (AF 49(638)269) AD 238483 Unclassified

The ultra-violet absorption spectra of shock-heated O_2 and NO have been photographed with high spectral resolution, and transition probabilities determined for the O_2 Schumann-Runge system and the NO gamma system. An upper limit to the transition probability for the NO beta system was established. Transition probabilities for the bands of 3 sequences of the O_2 Schumann-Runge system, associated with the zero, 1st and 2nd vibrational levels of the excited electronic state, yield an f value of 0.048 ± 0.008 which, when corrected for wavelength dependence, is about 1/3 that determined in the vacuum ultraviolet. This corresponds to a decrease in transition probability with increasing internuclear separation. Line-width variation with temperature and density have also been measured. The optical diameter for O_2 - O_2 collisions was determined as 6A and for O_2 - O collisions as 10A. For the NO gamma system, absorption spectra of the (0,1), (0,2), (0,3), (1,3), and (1,4) bands were photographed. High pressures were used to obliterate the rotational structure and the integrated absorption coefficients were determined. From these data, the electronic oscillator strength was calculated to be 0.0034 ± 25%. For the beta system, which was not observed on any spectrogram, the electronic oscillator strength was inferred to be less than approximately 0.006. (Contractor's abstract)

551

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

DECOMPOSITION OF NITRIC OXIDE BEHIND REFLECTED SHOCKS (Abstract), by E. Freedman, J. Daiber, and W. H. Wurster. [1959] [1]p. [AF 49(638)-269] Unclassified

Presented at meeting of the Amer. Phys. Soc., Ann Arbor, Mich., Nov. 23-25, 1959.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 134, Mar. 4, 1960.

Mixtures of 0.5% to 10% nitric oxide in argon were heated in a shock tube with helium drivers, and the decomposition behind the reflected wave was followed by recording the concentration of nitric oxide as a function of time. Continuum radiation of 400 μsec duration from a xenon flash lamp was passed through the gas and into a medium quartz spectrograph and then onto 2 photomultipliers placed behind the focal plane of the spectrograph. Two 20A windows around 2283A and 2465A were used, which correspond to spectral regions of strong oxygen absorption and to the bandhead of the (0,2) transition of nitric oxide, respectively. The data from the first channel made it possible to correct the data of the second channel for the effects of oxygen absorption. The results show that initially nitric oxide decomposes by a second order reaction, after which the reaction rate undergoes a sharp increase. The duration of the second order regime decreases from 27 μsec at 3000°K to about two at 3700°K. The second order rate constant is $10^{10.4}$ exp(-60,000/RT).

552

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

TRANSITION PROBABILITIES FOR NITRIC OXIDE IN THE FAR ULTRAVIOLET (Abstract), by J. W. Daiber and M. J. Williams. [1960] [1]p. [AF 49(638)-269] Unclassified

Presented at meeting of the Amer. Phys. Soc., Johns Hopkins U., Baltimore, Md., Nov. 21-23, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 213, Mar. 20, 1961.

Nitric oxide was heated in a shock tube up to 2200°K behind the reflected shock wave. Absorption spectra of the (0,1), (0,2), (0,3), and (1,4) bands of the gamma system were photographed, using a continuum light source and a medium quartz spectrograph. The NO was diluted in an argon bath in volume ratios from 0.08% to 10%. This was necessary for 2 reasons. First, it was essential to photograph the spectra before the NO decomposed detectably. An earlier study by Freedman and Daiber verified that argon dilution slows the NO decomposition rate because of reduction in NO partial pressure. The effectiveness of this dilution was confirmed by the absence of O_2 absorption on the resulting spectrograms. Secondly, high pressures were used to obliterate the rotational structure, and at the required pressures pure NO is totally absorbing. The wavelength-integrated absorption coefficients for each band were determined. From these data, the electronic oscillator strength was calculated to be 0.0034 ± 25%. This value is greater than the 0.0024 derived by Weber and Penner and by Bethke, from gas cell measurements at room temperature of the $\gamma(\nu', 0)$ sequence in the vacuum ultraviolet, and the value of 0.001 ± 50% based on the emissivities of 4000°K air by Keck et al. For the NO beta system, which was not observed on any spectrogram, the electronic oscillator strength was inferred to be less than 0.006. This value does not discriminate between Keck's -0.006 and Bethke's 0.0015.

553

Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

DECOMPOSITION RATE OF NITRIC OXIDE BETWEEN 3000 AND 4300°K, by E. Freedman and J. W. Daiber. [1960] [8]p. incl. diagrs. tables, refs. [AF 49(638)269] Unclassified

Published in Jour. Chem. Phys., v. 34: 1271-1278, Apr. 1961.

Time resolved absorption spectra of shock-heated nitric oxide in the far ultraviolet have been taken using photoelectric detection. The decomposition rate of nitric oxide between 3000 and 4300°K was thereby measured. The initial rate was found to be the sum of the direct dissociation reaction, NO + Ar → N + O + Ar, with $k = 10^{12}$ exp (- 150,000/RT) 1/mol sec, and the bimolecular reaction, 2 NO → N_2 + O_2, with $k = 4.8 \times 10^{20} T^{-5/2}$ exp (- 85,500/RT) 1/mol sec. (Contractor's abstract)

554

Cornell U. [Center for Radiophysics and Space Research] Ithaca, N. Y.

DEVICE FOR MEASUREMENT OF THE ELECTRICAL PROPERTIES OF Bi_2Se_3 AT ELEVATED TEMPERATURES, by M. J. Smith, E. S. Kirk, and C. W. Spencer. [1960] [2]p. incl. illus. diagrs. (AFOSR-TN-60-631) [AF 49(638)480] AD 251227 Unclassified

The construction of the apparatus is described. The device permits measurements up to about 600°C in an atm of Bi_2Se_3 or Bi_2Se_3-Se mixture. Conductivity and Hall effect measurements give an energy gap for Bi_2Se_3 of 0.36 ev, and electron mobilities of 2600 and 1600 sq cm/v-sec for a specimen containing 4×10^{17} and 5×10^{17} electrons/cu-cm at -80°C and 25°C, respectively.

555

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

MASS SPECTRA OF ALUMINUM (III) HALIDES AND THE DISSOCIATION ENERGIES OF Al_2F_6 AND $LiF{\cdot}AlF_3(g)$, by R. F. Porter and E. Zeller. [1960] [21]p. incl. tables. (AFOSR-TN-60-340) (AF 18(603)1) AD 246165 Unclassified

Also published in Jour. Chem. Phys., v. 33: 858-863, Sept. 1960.

Mass spectra of gaseous aluminum (III) chloride and bromide are obtained and interpreted qualitatively in terms of the degree of association in the vapor phase. Ion currents indicative of a molecular trimer of $AlCl_3$ are observed. Mass spectra of the vapors effusing from a Knudsen cell containing AlF_3 are obtained and the stability of the molecular dimer of $AlF_3(g)$ is determined quantitatively. Mass spectra of vapors from $LiF\text{-}AlF_3$ mixtures indicate the existence of a stable $LiF{\cdot}AlF_3(g)$ molecule. Ion current data are obtained as a function of condensed phase composition. A 2nd complex molecular species which appears to be either $(LiF)_2{\cdot}AlF_3(g)$ or $(LiF{\cdot}AlF_3)_2(g)$ is observed. For the reaction $Al_2F_6(g) = 2AlF_3(g)$, $\Delta H^\circ_{1000} = 48.0 \pm 4.0$ kcal/mol dimer and for $LiF{\cdot}AlF_3(g) = LiF(g) + AlF_3(g)$, $\Delta H^\circ_{1000} = 73 \pm 4$ kcal/mol. (Contractor's abstract)

556

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

STABILITIES OF GASEOUS MOLECULES IN THE Pb-Se AND Pb-Te SYSTEMS, by R. F. Porter. [1960] [21]p. incl. diagrs. tables, refs. (AFOSR-TN-60-946) (AF 18(603)1) Unclassified

Also published in Jour. Chem. Phys., v. 34: 583-587, Feb. 1961.

Mass spectrometric analyses of the vaporization products of phases near compositions PbSe and PbTe indicate that these substances vaporize primarily as molecular PbSe(g) and PbTe(g), respectively. Ion fragmentation processes originating from electron bombardment of vapors effusing from a conventional Knudsen cell interfere with quantitative determination of thermochemical dissociation energies of PbSe(g) and PbTe(g). The use of double oven-type Knudsen cells provided a means for the study of the dissociation of PbSe(g) and PbTe(g) into the gaseous elements. Dissociation energies of PbSe(g) and PbTe(g) were found to be 61.5 ± 2.5 and 51.4 ± 2.0 kcal/mol, respectively. The dissociation energy of $Te_2(g)$ was found to lie close to the published spectroscopic value. (Contractor's abstract)

557

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

MASS SPECTRA OF VAPORS IN THE $Al\text{-}AlF_3$ AND $Al\text{-}LiF\text{-}AlF_3$ SYSTEMS, by R. F. Porter. [1960] [2]p. incl. diagr. [AF 18(603)1] Unclassified

Published in Jour. Chem. Phys., v. 33: 951-952, Sept. 1960.

For 100 v ionizing electrons, the major ions observed in the vapors associated with both mixtures are AlF^+, Al^+, and AlF_2^+ with a high intensity of Li^+ also present with the $Al\text{-}LiF\text{-}AlF_3$ system.

558

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

DEVIATIONS FROM THERMAL EQUILIBRIUM AMONG REACTANT MOLECULES, by B. Widom. [1960] [7]p. incl. refs. (AFOSR-32) [AF 18(603)111] AD 261428 Unclassified

Presented at Symposium on Experimental and Theoretical Advances in Elementary Gas Reactions, St. Louis, Mo., Mar. 27-30, 1961.

Also published in Jour. Chem. Phys., v. 34: 2050-2056, June 1961.

A model of a chemically reacting system is considered in which the reactant molecules are dilutely dispersed in an inert gas and reaction is the result of binary collisions between inert and reactant species. It is noted that during reaction the distribution of reactants over their internal states is not that characteristic of equilibrium. It is shown that if k is the rate constant of the reaction k_{eq} the rate constant that would have characterized the reaction had the reactants been in equilibrium, then $k = k_{eq} - \bar{\tau}(q)^2 - (q)^2$ where $\bar{\tau}$ is a mean relaxation time, q is the reaction probability per unit time from a particular reactant state, and ( ) is an average over reactant states with an equilibrium distribution.

559

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

SOME SOLID STATE STUDIES OF SILVER-DOPED WO_3, by M. J. Sienko and B. R. Mazumder. Dec. 19, 1959 [6]p. incl. diagr. (AFOSR-TN-60-6) (AF 49(638)191) AD 613306 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 3508-3510, July 20, 1960.

A material corresponding to $Ag_{0.010}WO_3$ was isolated from the thermal equilibration of WO_3 with various Ag-sources. Single crystal studies indicated that it was orthorhombic (a = 7.35A, b = 3.73A, and c = 3.85A) and that it conducted as a metal between 25° and 600°C (specific resistivity increases linearly from 0.072 ohm-cm at 25°C to 0.155 ohm-cm at 600°C). The electron mobility at 25°C of 0.44 sq cm/v-sec was approximately the same as that previously observed in thallium tungsten bronze. It is proposed that $Ag_{0.010}WO_3$ represents a defect structure in which the 5 d conduction band of WO_3 is populated by electrons from the Ag atoms and in which a more symmetric structure of WO_3 has been stabilized by configurational entropy. (Contractor's abstract)

560

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

CN STRETCHING BANDS IN THE RAMAN SPECTRA OF SOME GROUP Ib AND GROUP IIb COMPLEX CYANIDES, by G. W. Chantry and R. A. Plane. Mar. 22, 1960, 10p. incl. table, refs. (AFOSR-TN-60-330) (AF 49(638)279) AD 234794; PB 149681 Unclassified

Also published in Jour. Chem. Phys., v. 33: 736-740, Sept. 1960.

The Raman spectra of solutions containing cuprous, argentous and mercuric ions together with cyanide ions indicate the presence of the di-, tri and tetra coordinated complexes. The spectra from solutions containing zinc and cadmium ions, respectively, with cyanide ions show, on the other hand, only the tetra coordinated complex. (Contractor's abstract)

561

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

RAMAN INTENSITIES AND THE STRUCTURE OF SOME OXYANIONS OF GROUP VII, by G. W. Chantry and R. A. Plane. [1960] [4]p. incl. table. (AFOSR-1689) (AF 49(638)279) Unclassified

Also published in Jour. Chem. Phys., v. 34: 1268-1271, Apr. 1961.

In order to obtain information concerning bonding and to test a hypothesis concerning the non-existence of BrO_4^-, the absolute intensities and depolarization ratios have been determined for Raman lines of ClO_3^-, BrO_3^-, IO_3^-, IO_4^-, and H_5IO_6. From the data, values of $\bar{\alpha}'_{xo}$ are obtained. These show that ClO_3^- resembles previously studied ions in containing sufficient π bonding to achieve essential electrical neutrality. Values for the other oxyhalides are consistent with this intrepretation; however, an independent criterion based on depolarization ratios (which are apparently greater for BrO_3^- and IO_3^- than for ClO_3^-) indicates that there is less π bonding in BrO_3^- and IO_3^- than in ClO_3^-. Since neither criterion can be applied rigorously to the present examples, it is difficult to decide which explanation is correct or whether the truth lies intermediate between the two extremes. (Contractor's abstract)

562

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

THE ASSOCIATION OF TRISETHYLENEDIAMINE-PLATINUM (IV) WITH VARIOUS ANIONS, by C. J. Nyman and R. A. Plane. [1960] [4]p. incl. diagr. tables, refs. (AFOSR-1690) (AF 49(638)279) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 5787-5790, Nov. 20, 1960.

The extent of association of $Pt(en)_3^{+4}$ with Cl^-, Br^-, $SO_4^=$, NO_3^- and ClO_4^- were determined from measurements of absorption spectra in the region 255 to 270 mμ. Of these anions all but the last were found to form a 1 to 1 outer-sphere ion-pair. An extended Debye-Hückel activity coefficient equation was used to determine values of association constants at infinite dilution. The values thus found were 11 for Cl^-, 8 for Br^-, 3.3×10^3 for $SO_4^=$ and 0.8 for NO_3^-. The lack of increased absorption when ClO_4^- is added to solutions of $Pt(en)_3^{+4}$ and the fact that $ClO_4^=$ does not lower the association of Cl^- with $Pt(en)_3^{+4}$ at constant ionic strength are taken to indicate that the association of even a +4 complex cation with ClO_4^- is negligible. (Contractor's abstract)

563

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

BOND POLARIZABILITY COMPONENTS, by G. W. Chantry and R. A. Plane. [1960] [2]p. (AFOSR-4309) [AF 49(638)279] Unclassified

Published in Jour. Chem. Phys., v. 33: 634-635, Aug. 1960.

Available Raman intensity data were used to calculate the bond polarizability components for CCl_4. It seems probable that derived bond polarizabilities give more information concerning the bonding electrons than do the bond polarizabilities themselves, since the polarizability of the inner core electrons should vary only slightly with changing internuclear distance.

564

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

THE ELIMINATION OF ANION INTERFERENCE IN FLAME SPECTROSCOPY, by W. D. Cooke. May 28, 1960 [19]p. incl. diagrs. tables, refs. (AFOSR-TN-60-588) (AF 49(638)484) Unclassified

Also published in Anal. Chem., v. 32: 1471-1474, Oct. 1960.

A method has been devised for eliminating anion interference in flame spectroscopy. (Ethylenedinitrilo) tetraacetic acid, when added to the solution being analyzed, enhances emissivity and maintains a constant level of intensity which is independent of the anion present. Elimination of interferences of a variety of anions including phosphate and sulfate was found for calcium, magnesium, cobalt, copper, chromium and manganese. Some of the experimental variables in flame spectroscopy were examined and an instrument is described which has a stability of 2% over a period of 2 months. (Contractor's abstract)

565

Cornell U. [Dept. of Engineering Physics] Ithaca, N. Y.

STUDY OF THE BORDONI INTERNAL FRICTION PEAKS IN COPPER, by V. K. Paré. [1960] [9]p. incl. diagrs. tables, refs. [AF 18(600)1000] Unclassified

Published in Jour. Appl. Phys., v. 32: 332-340, Mar. 1961.

The internal friction of several cold-worked copper single crystals was measured between 4° and 300°K at 4 kc. Vibrational strain amplitudes ranging from 10^{-7} - 2 x 10^{-5} were used. In pure samples the height of the Bordoni relaxation peak increased slightly with strain amplitude, but in all samples the activation energy of the relaxation process was not affected. This conclusion may be reconciled with the theory of Donth - and some other aspects of the measurements (e.g., peak width) can be clarified - by assuming that the dislocations participating in the relaxation process are under internal stresses resulting from prior cold work. An activation energy of 0.12 ev is consistent with the present data, but the range of frequency represented in the comparison is not sufficient to determine the value accurately. It is shown that the subsidiary peak consists of 2 separate peaks at about 30° and 40°K.

566

Cornell U. [Dept. of Mathematics] Ithaca, N. Y.

A CHANNEL WITH INFINITE MEMORY, J. Wolfowitz. [1960] [5]p. (AF 18(600)685) Unclassified

Also published in Proc. Fourth Berkeley Symposium on Mathematical Statistics and Probability, California U., Berkeley (June 20-July 30, 1960), Los Angeles, California U. Press, 1961, v. 1: 763-767. (AFOSR-2135)

A stationary, nonanticipating channel with an infinite past R is considered. A method is described by which the capacity of this channel can be determined. A coding theorem and converse theorem are proven.

567

Cornell U. Dept. of Physics, Ithaca, N. Y.

DETERMINATION OF SURFACE STRUCTURE USING ULTRA-HIGH VACUUM REPLICATION, by L. Bachmann, W. H. Orr and others. [1960] [24]p. incl. illus. diagrs. refs. (Technical rept. no. 15) (AFOSR-TN-60-289) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)674, Task I, and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 191, Mar. 21, 1960.

Also published in Jour. Appl. Phys., v. 31: 1458-1462, Aug. 1960.

Electron microscopy has been applied to the problem of characterizing the distribution of preferred sites for nucleation and growth on clean surfaces of evaporated films of magnesium metal. The films were deposited, platinum-shadowed, and carbon-backed in the same system under ultra-high vacuum conditions to minimize surface contamination and to improve the fidelity of surface replication. Upon examination of both clean and oxidized films in the electron microscope, the distribution of the platinum deposit was observed to be markedly influenced by the vacuum conditions used in the replication procedure. In addition, the particle size and separation of the platinum grains and their distribution, with relation to the substrate, indicated an enhanced surface mobility on cleaved mica and an apparent reaction on magnesium. These observations may have bearing on both the surface properties of metal deposits and on the development of high-resolution replication techniques. (Contractor's abstract)

568

Cornell U. Dept. of Physics, Ithaca, N. Y.

DETERMINATION OF THE THICKNESS OF THIN FILMS BY INELASTIC SCATTERING OF ELECTRONS, by L. Bachmann and B. M. Siegel. [1960] [7]p. incl. diagrs. (AFOSR-TN-60-630) (AF 18(600)674, Task I) Unclassified

Presented at the European Regional Conf. on Electron Microscopy, Delft (Netherlands), Aug. 28-Sept. 3, 1960.

By adjustment of the optics of the electron microscope and using a Faraday cage in the instrument to measure the absolute incident intensity and to calibrate each photographic plate, the absolute scattering distribution is obtained from a given area of film. Calibrating against measured thicknesses of carbon films and deposits of copper for which the mass per unit area has been measured, a method has been developed for determining the mass per unit area, or "mass-thickness" if density is known, of small areas of very thin films and deposits. The results from experiments on mass-thickness determinations from scattering show that the largest error introduced is actually the calibration of the thickness. The colorimetric analysis gives a value good to ± 0.5A for carbon and ± 0.3A for copper. The values obtained by this method for differential cross-section of scattering are also compared to published data from other investigators. It is shown that the method affords very reliable information.

569

Cornell U. Dept. of Physics, Ithaca, N. Y.

INVESTIGATIONS ON THE DEPOSITION OF CADMIUM ON MICA SURFACES, by G. S.-Y. Yeh. June 15, 1960 [45]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 17) (AFOSR-TN-60-755) (AF 18(600)674, Task I)
AD 243499 Unclassified

The nucleation and growth of cadmium crystallites during deposition from the vapor phase on mica has been investigated using the electron microscope. In the range of incident vapor densities studied, the mica must be cooled to temperatures below -70°C before critical nuclei will form. At temperatures above -120° to -130°C nucleation appears to be very rapid and subsequent deposition causes only growth of the crystallites. When the mica substrate is cooled below -130°C the number of nuclei formed per unit area is proportional to the time of deposition and the activation energy of the process is much lower (1,400 cal/mol) than the process occurring on the warm substrates (5,900 cal/mol). By direct observation of these deposits with the electron microscope, data is obtained on the number and rate of crystallite nucleation, as well as the size and rate of growth of the crystals during deposition. (Contractor's abstract)

570

Cornell U. Dept. of Physics, Ithaca, N. Y.

A STUDY OF THE THERMIONIC POINT FILAMENT ELECTRON GUN, by M. R. Specht. July 1, 1960, 89p. incl. diagrs. tables, refs. (Technical rept. no. 18) (AFOSR-TN-60-756) (AF 18(600)674, Task I)
AD 262025; PB 153830 Unclassified

The brightness and diameter of the effective electron source produced by thermionic point filaments of 3μ, 2μ, and 1μ radii of curvature were determined as functions of the bias voltage. The peak brightness is found to vary between 48% and 78% of the theoretical maximum value expressed by Langmuir's formula. The source diameter is found to pass through a minimum value at bias voltages about 7% less negative than those which give maximum brightness. At 30 kv accelerating voltage, the minimum source diameter obtained is about 8μ. Some measurements of the brightness and source diameter were made with a point filament used in both the flat type bias shield and re-entry type shield. The data indicate that the flat shield produces a smaller effective electron source than the re-entry shield. Data was obtained which shows that the maximum brightness is proportional to the accelerating voltage as expressed by Langmuir's formula. The minimum source diameter is found to be approximately inversely proportional to the square root of the accelerating voltage. The maximum brightness of the effective source is found to be independent of the filament height. There is some evidence, however, that the minimum source diameter is dependent on the filament height, the source being smaller with greater filament height. The most significant result found in this experiment is that a minimum source diameter of about 8μ can be obtained with a point filament. A minimum source diameter of 3μ was obtained with an accelerating voltage of 30 kv. Assuming that the source diameter is inversely proportional to the square root of the accelerating voltage, a minimum source diameter of about 6μ could be expected with 50 kv accelerating voltage. The results of this investigation on the point filament electron gun indicate that this type of gun might advantageously be employed in electron microscopes and electron diffraction cameras when the need for a smaller effective source is sufficiently great to justify the additional time and care required to manufacture and align the point filament.

571

Cornell U. Dept. of Physics, Ithaca, N. Y.

INVESTIGATION OF ATOMIC PHENOMENA OCCURRING ON AND NEAR THE SURFACES OF SOLIDS, by R. C. Bradley. Final rept. Feb. 29, 1960, 10p. incl. refs. (AFOSR-TR-60-45) (AF 18(600)674, Task II)
AD 233535; PB 146433 Unclassified

This report describes the aims and accomplishments of Task II of an Air Force contract from its beginning in the fall of 1953 up until its expiration date of Jan. 31, 1960. The contract has been devoted entirely to the study of the surfaces of solids. Field emission microscopy was used for studying (1) the surface of an alloy, and (2) the kinetics of metals absorbed on metal substrates. Mass spectrometry was used to study (1) the nature and properties of secondary ions, (2) surfaces and bulk compositions, and (3) surface and bulk kinetics. The motivation for these studies was the desire to have a better understanding of important surface phenomena such as corrosion, catalysis, electron emission, etc.

572

Cornell U. [Dept. of Physics] Ithaca, N. Y.

REFLECTION OF INERT GAS IONS FROM COPPER (Abstract), by R. C. Bradley and E. Ruedl. [1960] [1]p. [AF 18(600)674, Task II] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 16, Jan. 27, 1960.

The study of the reflection of positive ions incident at 45° on a metal surface has now been extended to copper surfaces. Of particular interest are the following results: (a) the energy spread of the reflected ions was invariably less than 1 ev even for bombarding energies as high as 1000 ev; (b) despite this low energy certain directional effects were evident which did not seen to exist for other kinds of secondary ions (e.g., Cu^+ or K^+) from the same surface; (c) the yield (defined as the ratio of reflected ion current measured at the final collector to incident ion current) decreased with increasing temperature in the range 20° - 500°C and was reversible; (d) after the surface had been heated to 600°C for an hr the yield was much lower, but would build up again to a steady state value; (e) the yield was proportional to the background pressure of inert gas for pressures less than 1×10^{-5} mm Hg; (f) the yield increased with increasing bombarding energy up to about 250 ev and then slowly declined.

573

Cornell U. [Dept. of Physics] Ithaca, N. Y.

SECONDARY POSITIVE ION EMISSION FROM COPPER (Abstract), by E. Ruedl and R. C. Bradley. [1960] [1]p. [AF 18(600)674, Task II] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 16, Jan. 27, 1960.

Secondary positive ions ejected from single crystal copper surfaces under the action of inert gas ion bombardment have been analyzed in a high vacuum mass spectrometer using techniques previously described. Principal ion species were Cu^+ and CuO^+ (although both were absent after prolonged heating at 650°C), Na^+ and K^+ impurities, and "reflected" ions of the primary beam (e.g., Xe^+ or A^+). Cu_2^+ and Cu_2O^+ peaks were also observed but at a level 100 times lower than the Cu^+ and CuO^+ peaks. The Cu^+ and CuO^+ peaks seemed interdependent in that they were either both present or both absent. However, their dependences on bombardment parameters were very different. Activation energies for the volume diffusion of K^+ and Na^+ were measured and found to be 2.3 ± 0.1 and 2.5 ± 0.1 ev, respectively. The desorption energy of K^+ was 1.2 ± 0.1 ev.

574

Cornell U. Dept. of Physics, Ithaca, N. Y.

ELECTRONIC BAND STRUCTURE OF SOLIDS BY X-RAY SPECTROSCOPY, by L. G. Parratt. [1959] [30]p. incl. diagrs. tables, refs. (Technical rept. no. 8; Revision of AFOSR-TN-56-562a) (AFOSR-TN-60-1) (AF 49-(638)402) Unclassified

Also published in Rev. Modern Phys., v. 31: 616-645, July 1959.

Also published in Methods of Experimental Phys., N. Y., Academic Press, v. 6 (Part B): 281-292, 1959.

For abstract see item numbers COR.07:015, Vol. I and COR.07:017, Vol. II.

575

Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

UNSTEADY VISCOUS FLOW IN THE VICINITY OF A STAGNATION POINT, by N. Rott. [1954] [8]p. incl. diagrs. [AF 18(600)1523] Unclassified

Published in Quart. Appl. Math., v. 13: 444-451, Jan. 1956.

An exact solution of the Navier-Stokes equations for a viscous incompressible fluid is found for the case of stagnation-point flow against a plate oscillating in its own plane.

576

Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

VORTICITY EFFECT ON THE STAGNATION-POINT FLOW OF A VISCOUS INCOMPRESSIBLE FLUID, by N. Rott and M. Lenard. [1959] [2]p. (AF 18(600)1523) Unclassified

Published in Jour. Aero/Space Sci., v. 26: 542-543, Aug. 1959.

A commonly accepted improvement in boundary-layer theory is obtained by considering the inviscid flow past a body which is augmented by the displacement thickness of the viscous layer. The improvement involves the vorticity in the flow outside the boundary layer. In comparison, the effect of the displacement thickness, the effect of slip in low-density flow, and the effect of finite radius of curvature are discussed.

577

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

POTENTIAL FLOWS IN THE APPROXIMATION OF VISCOUS ACOUSTICS, by W. J. Rae. June 1960, 107p. incl. diagrs. refs. (AFOSR-TN-60-409) (AF 18(600)-1523) AD 236743; PB 147644 Unclassified

Steady, irrotational flows are studied in a linearized approximation, retaining the effects of dispersion and attenuation due to viscosity in the region outside the boundary layer. The differential equation for the velocity potential in this approximation is derived and discussed, and formal solutions for the flow around non-lifting two-dimensional and axisymmetric bodies are found. Approximate evaluations of the formal solution then reveal that throughout all of the subsonic, and most of the supersonic flow field, the inviscid solution is altered by a correction that is first-order in a viscosity parameter. In the supersonic cases, the familiar inviscid wave pattern tends to be dispersed in the vicinity of the body, and at great distances from the body, all disturbances decay. The rates of decay of pressure disturbances at these distances are found, and their relation to the inviscid, nonlinear treatment of the same problem is discussed. In the course of the Fourier analysis of the problem, a Fourier transform which is not listed in any of the standard tables is evaluated, and this provides a closed-form solution to a boundary-value problem involving a certain third-order partial differential equation. Both of these results are thought to be new. (Contractor's abstract)

578

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y

PRACTICAL PROBLEMS IN AERODYNAMICS. (n.a.) Final rept. Dec. 30, 1959, 12p. (AFOSR-TR-60-14) (AF 18(600)1523) Unclassified

The results of studies in a number of areas of modern aerodynamics are presented. The reports issued under this contract and all publications are briefly reviewed. This report emphasizes the fact that although it is customary to neglect the effects of viscosity outside the boundary layer, it is possible to determine the damping effects of viscosity throughout the flow field by means of the techniques used in acoustics. In this approximation the flow is considered to be irrotational but the disturbances produced by a solid body are diffused and attenuated. In the study viscosity effects are determined for both 2-dimensional and axisymmetric flow. It is concluded that viscosity effects are probably comparable with, or more important than, the effects of nonlinearity in attenuating the flow field at large distances.

579

[Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.]

EXPERIMENTAL STUDY OF AN ABLATING SPHERE WITH HYDROMAGNETIC EFFECT INCLUDED, by J. H. Boynton. [1960] [2]p. incl. illus. diagrs. (AF 18-(600)1523) Unclassified

Published in Jour. Aero/Space Sci., v. 27: 306-307, Apr. 1960.

Two mechanisms, material ablation and magnetohydrodynamic interaction, concerned with aerodynamic heating problems associated with re-entry are explained. The possibility of a re-entry vehicle employing both of these phenomena is discussed. Results show that the possibility exists for efficiently reducing heat-transfer rates to a blunt body by increasing the amount of material which vaporizes upon re-entry. The results also indicate the need for further quantitative experiments.

580

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

THEORY OF SUPERSONIC-PROPELLER AERODYNAMICS, by D. E. Ordway and R. W. Hale. [1960] [14]p. incl. diagrs. refs. [AF 18(600)1523] Unclassified

Published in Jour. Aero/Space Sci., v. 27: 437-450, June 1960.

A supersonic propeller with blades attached to an infinite cylinder as a hub is studied. The lightly loaded blades are represented by a surface distribution of appropriate "modified" sources similar to ordinary supersonic thin wing theory. These sources are found by approximating the exact potential for a constant-strength compressible source traveling along a helical path. Tip effects are considered by extending the theory of Evvard and Krasilshchikova.

581

Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

COMPRESSIBILITY EFFECTS IN A MAGNETOAERODYANMIC FLOWS PAST THIN BODIES, by J. E. McCune and E. L. Resler, Jr. [1960] [11]p. incl. diagrs. refs. (AF 18(600)1523) Unclassified

Published in Jour. Aero/Space Sci., v. 27: 493-503, July 1960.

The effects of compressibility on the steady motion of a highly conducting fluid past thin cylindrical bodies in the presence of a magnetic field are studied. Procedures are developed for the solution of this class of

magnetoaerodynamic problems over the entire Mach number range and for all ratios of magnetic to fluid-dynamic pressure. The results obtained are analogous either to the Ackeret theory or the Prandtl-Glauert rule of conventional aerodynamics, depending on the relative values of the flow speed disturbances. The methods used and the physical interpretation of the solutions obtained vary according to the orientation of the magnetic field with respect to the flow direction. The results of the theory are explained in terms of the anisotropic propagation of magnetoacoustic pulses studied previously by several authors. (Contractor's abstract)

582

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

A SUBLAYER THEORY FOR FLUID INJECTION INTO THE INCOMPRESSIBLE TURBULENT BOUNDARY LAYER, by D. L. Turcotte. [1960] [4]p. incl. diagrs. (AF 18(600)1523) Unclassified

Published in Jour. Aero/Space Sci., v. 27: 675-678, Sept. 1960.

A sublayer is introduced in which the intensity of turbulence grows at a prescribed rate. The decrease in wall shear stress due to fluid injection into the boundary layer is found under the hypothesis that the effect of injection is restricted to the sublayer region. Experimental measurements of the velocity profiles with fluid injection substantiate this hypothesis. The theoretical decrease in wall shear stress is in good agreement with experiment; the solution is particularly simple, and for small values of the injection parameter it contains no arbitrary parameters. The theory provides a similarity parameter which differs from the one in general use. (Contractor's abstract)

583

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

UNSTEADY MAGNETOHYDRODYNAMIC FLOW ABOUT THIN AIRFOILS, by L. E. Ring. June 1960, 143p. incl. diagrs. refs. (AFOSR-TN-60-638) (AF 49(638)544) AD 243016 Unclassified

The theory is developed for the magnetohydrodynamic flow of an incompressible fluid about thin airfoils in non-uniform motion. A uniform magnetic field is applied parallel to the free stream and solutions are obtained subject to the restriction of small perturbations. The effects of viscosity are included, for the most part, only through the application of the usual Kutta condition for lifting airfoils. The general character of the flow is discussed at length. The validity and range of applicability of the infinite-conductivity and moderate-conductivity theories are determined on the basis of an order-of-magnitude analysis. The flow-field for infinite conductivity is changed from the non-magnetic case only through the new transport speed of vorticity; the forces on the airfoil are changed due to surface currents. For the case of the Alfvén speed less than the free-stream speed, the airfoil lift and pitching moment are given in integral form for general unsteady-airfoil motion and are given in closed form for harmonic oscillations. The forces at moderate frequencies are found to be larger than the corresponding non-magnetic case. The response to a unit step-function change in the downwash is studied and the asymptotic form of the lift is obtained for small and large time. Using the Oseen approximation, a set of singular solutions with arbitrary conductivity and magnetic field strength are obtained for harmonic oscillations. Limiting forms of these singular solutions are given for low frequencies. Using these solutions, integral equations are formulated for the case of an oscillating airfoil, which may be a conductor or an insulator. (Contractor's abstract)

584

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

ANALYTIC SOLUTIONS FOR THE SURFACE TEMPERATURES DUE TO AERODYNAMIC HEATING, by A. L. Kaskel. June 1959, 64p. incl. diagrs. refs. (AFOSR-TN-60-643) (AF 49(638)544) AD 243017 Unclassified

The transform procedures of operational calculus are used to obtain analytical solutions for the surface temperatures of a solid-symmetric airfoil at zero angle of attack, when the heat transfer coefficient and the recovery temperature of the fluid through which the wing is moving can be expressed by polynomials, exponentials, the product of polynomials and exponentials, or the sum of polynomials and exponentials. The solution for the surface temperature of a hollow wing in which the inner surface of the wing is insulated is also included, along with an approximate solution for the surface temperatures of the solid wing at small angles of attack. The transform procedures are applied to a set of simultaneous integral equations for the upper and lower surface temperatures of the wing. These equations are obtained by making a heat balance between the heat inflow to the wing from aerodynamic heating and the internal temperature gradients at the upper and lower surfaces of the wing. The temperature gradients are obtained from Fourier's one dimensional heat flow equation by using the principle of superposition and Duhamel's integral to find the temperature distribution inside the wing due to the application of an arbitrary upper and lower surface temperature. A special approximation is made to the exact solution for the hollow wing, and an example is worked out to show the results that can be expected by using this approximation. The results are compared with an existing exact solution for the hollow wing with the inner surface insulated. (Contractor's abstract)

585

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

THEORY OF LINEARIZED TIME-DEPENDENT BOUNDARY LAYERS, by S. H. Lam and M. Rott. Final rept. July 1960 [51]p. incl. diagrs. (AFOSR-TN-60-1100) (AF 49(638)544) AD 246519 Unclassified

A class of laminar, two-dimensional, time-dependent, incompressible, boundary-layer flows is considered. The generalization to flow with arbitrary small time dependence can be made by transform techniques. The major goal is to resolve certain mathematical peculiarities of this category of unsteady, flat-plate flows, but most of the analysis is not restricted to the flat plate. The question of the joining of the low-frequency and high-frequency series solutions is given special attention. High-frequency eigen-solutions provide the freedom necessary for the joining. Extensive numerical computations, performed to substantiate the theory, are presented. (Contractor's abstract)

586

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

THE THEORY OF THE JET-FLAP FOR UNSTEADY MOTION, by D. A. Spence. [1960] [22]p. incl. diagrs. (AFOSR-TN-60-1267) (AF 49(638)544) Unclassified

Published in Jour. Fluid Mech., v. 10: 237-258, Mar. 1961.

Linearized methods developed in earlier papers are used to discuss the non-stationary flow of a wing with a jet-flap. A thin two-dimensional wing at zero incidence in a steady stream of speed U, with a thin jet emerging parallel to the chord at the trailing edge, and the motion following an instantaneous deflection of the jet through an angle τ_0 are considered. If the momentum-flux coefficient C_J of the jet is $\ll 4$, the governing equations can be put in a form in which C_J does not appear explicitly, and a similarity solution then gives the shape of the jet at small times t from the start of the motion as a function of $(x - c)\mu^{-1/3}t^{-2/3}$, where $x = c$ is the trailing edge and $\mu = 1/4C_J$. The solution is obtained from a certain third-order integro-differential equation, by constructing the Mellin transform of the non-dimensional shape. When t is large the jet near the wing appraches the shape given by the known results for steady flow, but its shape at distances of the order of Ut downstream changes diffusively under the action of the starting vortex. A similarity solution is also found for the flow in the region if terms of $(x - Ut)\mu^{-1/3}t^{-2/3}$, without restriction to small μ. Expressions for the lift coefficient at small and large times are found, and the case of an oscillating deflection angle is treated by the same methods.

587

Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

THE LIFT COEFFICIENT OF A THIN JET-FLAPPED WING. II. A SOLUTION OF THE INTEGRO-DIFFERENTIAL EQUATION FOR THE SLOPE OF THE JET, by D. A. Spence. [1960] [22]p. incl. diagrs. table, refs. (AFOSR-TN-60-1268) [AF 49(638)544] Unclassified

Published in Proc. Royal Soc., v. 261A: 97-118, 1961.

In an earlier paper with the same general title (Proc. Royal Soc., v. 238A: 46-68, 1956) a mathematical model was developed to discuss the flow past a 2-dimensional wing at incidence α in a steady incompressible stream, with a jet of momentum coefficient C_J emerging from the trailing edge at an angular deflection γ to the chordline. In linearized approximation it was shown that the slope of the jet is given by a certain singular integro-differential equation, and numerical solutions for the equation were obtained by a pivotal points method. A coordinate transformation has now been found which makes the equation independent of the jet strength for small values of $1/4C_J = \mu$, say, yielding a simpler equation solved by Lighthill using Mellin transforms and by Stewartson and the present author by other methods. In this paper the expansion of the slope function is continued in ascending powers of μ and $\ln \mu$ multiplied by functions of x found by solving by Lighthill's method, a series of closely-related inhomogeneous equations. From these, expansions of the lift derivatives with respect to α and τ are found as $\frac{1}{4\sqrt{(\pi\mu)}} \frac{\partial C_L}{\partial \tau} = 1 - \frac{\mu}{2}(\ln\frac{\mu}{\beta}) - \frac{\mu^2}{8\pi^2}\left[(\ln\frac{\mu}{\beta})^2 + 4\ln\frac{\mu}{\beta} - 4\right] + \ldots$, $\frac{1}{2\pi}\frac{\partial C_L}{\partial \alpha} = 1 - \frac{\mu}{\pi}(1 + \frac{\mu}{\pi})\ln(\frac{\mu}{\beta} - 1) + \ldots$, where $\beta = 4e^{\gamma}$. To this order the expressions agree closely with the numerical results found earlier, the discrepancy at $\mu = 1$ being less than 4%. (Contractor's abstract)

588

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

ON THE CONCEPTS OF MOVING ELECTRIC AND MAGNETIC FIELDS IN MAGNETOHYDRODYNAMICS, by J. E. McCune and W. R. Sears. Mar. 31, 1959 [2]p. (AFOSR-3408) (AF 49(638)544) Unclassified

Also published in Jour. Aero/Space Sci., v. 26: 674-675, Oct. 1959.

Recently there have appeared in the literature certain statements regarding "moving magnetic fields" which if not erroneous, are at least misleading if applied without further consideration to problems of magnetohydrodynamic interest. For example, motion in a conducting fluid of an infinite flat plate in the presence of a uniform transverse magnetic field has been discussed and distinguished in 2 cases: (1) the source of the magnetic field "fixed relative to the plate" and (2) the source of the magnetic field "fixed relative to the fluid" far from the plate. It is pointed out that the separate cases treated by these authors (Rossow, Ong, and Nicholls), which are distinguished according to the state of motion of the magnetic field, can be more correctly thought of as corresponding to different values of the applied electric field. By interpreting these cases as suggested, it can be shown that the linearized results obtained correspond to interesting and useful magnetohydrodynamic problems.

589

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

LOSSES IN A JET-FLAP COMPRESSOR CASCADE, by E. F. Brocher. Sept. 1959, 63p. incl. illus. diagrs. tables. (AFOSR-3418) (AF 49(638)544) Unclassified

Jet-flap compressor blades in cascade are investigated to determine their efficiency in preventing stall. In addition to the direct improvements in the cascade characteristics there are two other distinct advantages of a jet-flap compressor first stage for the prevention of rotating stall in subsequent stages: (1) a more uniform velocity profile downstream and (2) an increased axial velocity downstream. These gains cannot be achieved with boundary layer suction. Furthermore, the power requirements for the jet-flap at low jet coefficients and large slot widths should be about the same as for suction techniques.

590

Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

SOME EXACT SOLUTIONS IN LINEARIZED MAGNETOAERODYNAMICS FOR ARBITRARY MAGNETIC REYNOLDS NUMBERS, by E. L. Resler, Jr. and J. E. McCune. [1960] [7]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)544] and Office of Naval Research) Unclassified

Presented at Symposium on Magneto-Fluid Dynamics, Williamsburg, Va. and Washington, D. C., Jan. 18-23, 25, 1960. (AFOSR-303)

Published in Rev. Modern Phys., v. 32: 848-854, Oct. 1960.

Compressible linearized equations and solutions for the flow past an insulating sinusoidal wall with various magnetic field geometries are studied. Addition of the electromagnetic equations to the fluid flows leads to Alfvén waves so that even compressible flows have a wave character. Finite electrical conductivity introduces current diffusion, while compressibility effects bring in sound waves modified by the currents and Alfvén waves modified by the compressibility. Interaction is complex and depends strongly on the magnetic field strength and geometry.

591

Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

COMMENTS ON THE BEHAVIOR OF SEDOV'S BLAST-WAVE SOLUTION AS $\gamma \rightarrow 1$, by E. F. Brocher. [1960] [2]p. (AF 49(638)544) Unclassified

Published in Jour. Aero/Space Sci., v. 27: 955-956, Dec. 1960.

The limitations of Freeman's comments (item no. 1740, Vol. III) on the explosion solution of Sedov are pointed out and a presentation made on how these limitations can be removed. A uniform approximation to Sedov's solution for the planar, cylindrical, and spherical cases is made. An expansion procedure to get higher order approximations is also demonstrated. In addition it is shown that the range of validity of the blast-wave analogy with steady hypersonic flow tends to 0 as $\gamma \rightarrow 1$.

592

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

BUOYANCY EFFECTS IN FORCED LAMINAR CONVECTION FLOW OVER A HORIZONTAL FLAT PLATE, by Y. Mori. [1960] [4]p. incl. diagrs. table. (AFOSR-TN-60-1413) [AF 49(638)674] Unclassified

Presented at annual winter meeting of the Amer. Soc. of Mech. Engineers, New York, Nov. 27-Dec. 2, 1960.

Also published in Jour. Heat Transfer, v. 83: 479-482, Nov. 1961.

The purpose of this paper is to analyze the effects of buoyancy, that is, a large Grashof number on forced laminar convective heat transfer and to find when and how the Grashof number must be taken into account in this case. In forced laminar boundary-layer flow over a horizontal flat plate buoyancy was taken into account in the equation of motion in the direction perpendicular to the plate. The magnitude of the effects of buoyancy on the velocity and temperature field are shown to be proportional to $Gr_x/Re_x^{2.5}$, where Gr_x is the local Grashof number and Re_x is the local Reynolds number.

When the temperature of the plate is higher than that of the fluid, it is shown that both the shear stress and the heat transfer at the surface are reduced by buoyancy in the flow above the plate, while they are increased in the flow below it. (Contractor's abstract)

593

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

STEADY FLOW OF CONDUCTING FLUIDS IN CHANNELS UNDER TRANSVERSE MAGNETIC FIELDS, WITH CONSIDERATION OF HALL EFFECT, by I. Tani. [1960] [9]p. incl. diagrs. refs. (AFOSR-20) (AF 49(638)-674) Unclassified

Also published in Jour. Aero/Space Sci., v. 29: 297-305, Mar. 1962.

An approximate method of solution based on a minimum principle is presented for the steady laminar incompressible flow of an electrically conducting fluid through a straight channel of arbitrary cross section with conducting or nonconducting walls in the presence of a uniform transverse magnetic field. The Hall effect is taken into account by making simplifying assumptions that the gas is fully ionized and that both Reynolds number and magnetic Reynolds number are small. Numerical calculations are carried out for the case of a rectangular channel. (Contractor's abstract)

594

Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

SOME EXACT SOLUTIONS IN LINEARIZED MAGNETO-AERODYNAMICS FOR ARBITRARY MAGNETIC REYNOLDS NUMBERS, by E. L. Resler, Jr. and J. E. McCune. [1960] [7]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)716] and Office of Naval Research) Unclassified

Presented at Symposium on Magneto-Fluid Dynamics, Williamsburg, Va. and Washington, D. C., Jan. 18-23, 25, 1960. (AFOSR-303)

Published in Rev. Modern Phys., v. 32: 848-854, Oct. 1960.

A general treatment of the linearized equations is presented and special solutions for the flow past an insulating sinusoidal wall with various magnetic field geometries are given. Arbitrary values of the conductivity and compressibility are included and some numerical estimates of magnetoaerodynamic effects observable in the laboratory are made. It is shown that the compressible linearized equations of magnetoaerodynamics can be solved in some simple cases. These examples serve to illustrate many of the phenomena common to this field. The addition of the electromagnetic equations to the fluid flows leads to Alfvén waves so that even incompressible flows have a wave character. Finite electrical conductivity introduces current diffusion, while compressibility effects bring in sound waves modified by the currents and Alfvén waves modified by the compressibility. The interaction is complex and depends strongly on the magnetic field strength and geometry. The appropriateness of approximate theories for large electrical conductivity is seen to depend not only on R_m but also on the geometry of the field. The geometry governs whether the flow field is affected by an Alfvén wave mechanism or current diffusion, the wave mechanism being by far the more powerful. Under certain conditions the magnetic field makes possible the propagation of disturbances counter to the fluid stream.

595

Cornell U. Lab. of Atomic and Solid States Physics, Ithaca, N. Y.

SECONDARY POSITIVE ION EMISSION FROM PLATINUM, by R. C. Bradley, A. Arking, and D. S. Beers. Dec. 1, 1960 [6]p. incl. diagrs. refs. (Technical rept. no. 1) (AFOSR-TN-60-1466) (AF 49(638)748) AD 254117 Unclassified

Also published in Jour. Chem. Phys., v. 33: 764-769, Sept. 1960.

Mass analysis of the secondary particle ejected from Pt surfaces by inert gas ion bombardment or by heating revealed species characteristic of the base metal of certain bulk and surface impurities, and of the bombarding beam (so-called reflected ions). The Pt^+ ions seemed to come directly from the substrate rather than from surface compounds. Their yield increased with temperature, bombarding ion energy, and bombarding ion mass. The ratio of sputtered Pt ions to sputtered neutrals is estimated to be of the order of 1 to 1000 at room temperature. The kinetics of the formation and desorption of a certain surface compound (possibly $Pt(CO)_2$) was studied by secondary ion analysis. The compound formed spontaneously on the surface from the background gas in the instrument (CO). Its formation rate was greatly enhanced by inert gas ion bombardment. It desorbed readily at 1000°C with an activation energy of 0.74 ± 0.05 ev. The reflected ions appeared to be sputtered rather than reflected. Their energy was always extremely low (less than 1 ev) and the dependence of their yield on ambient gas pressure and target temperature is consistent with the notion that they originated from inert gas atoms trapped in the surface layers. (Contractor's abstract)

596

Cornell U. [Sibley School of Mechanical Engineering] Ithaca, N. Y.

A NOTE ON THE LIMITING RELATIVE EFFICIENCY OF THE WALD SEQUENTIAL PROBABILITY RATIO TEST, by R. Bechhofer. [1960] [4]p. incl. refs. (AFOSR-TN-60-35) (AF 49(638)230) AD 231840; PB 145776 Unclassified

Also published in Jour. Amer. Stat. Soc., v. 55: 660-663, Dec. 1960.

The efficiency of the Wald sequential probability ratio test relative to the best competing fixed sample procedure for testing $H_0: \theta = \theta_0$ versus $H_1: \theta = \theta_1$ $(\theta_0 < \theta_1)$ when X is distributed $N(X|\theta,\sigma^2)$ with known σ^2 is studied for fixed $(\theta, \theta_0, \theta_1)$ as the specified probabilities of error, α (the probability of rejecting H_0 when $\theta = \theta_0$) and β (the probability of accepting H_0 when $\theta = \theta_1$), approach zero. The limit depends on the relative rates at which α and β approach zero in a prescribed manner. In particular, when $a\alpha = \beta$ $(a > 0)$ this limiting relative efficiency equals $(\theta_1 - \theta_0)/(4|\theta_1 + \theta_0 - 2\theta|)$. (Contractor's abstract, modified)

Cruft Lab., Cambridge, Mass.
see Harvard U. Cruft Lab., Cambridge, Mass.



597

De Paul U. [illegible] of Chemistry, Chicago, Ill.

THIOPHOSGENATION OF DIMETHYLAMMONIUM CHLORIDE, by E. Lieber and J. P. Trivedi. [1960] 5p. incl. table. (AFOSR-TN-60-84) [AF 49(638)474] Unclassified

Also published in Jour. Org. Chem., v. 25: 650-651 Apr. 1960.

A study was made on the reaction of using dimethylammonium chloride, $(CH_3)_2NH_3Cl$, and thiophosgene, $CSCl_2$, in the presence of aqueous NaOH. Temperature was found to be the most important variable of the reaction regardless of whether the aqueous phase ended up in an acidic or alkaline condition. The thiophosgenation reaction gave the following results expressed with respect to temperature (ratio of NaOH/Me_2NH_3Cl, % yield of dimethylthiocarbamyl chloride): 28° (1, 2); 28° (2, 7); 28° (2.5, none); 20° (2.7, 25, of which 4% was tetramethylthiuram monosulfide and 5% was tetramethylthiourea); 10° (2, 15); 0° to -5° (2, 38); and -10° to -20° (2, 46-50).

598

De Paul U. Dept. of Chemistry] Chicago, Ill.

REACTION OF THIOPHOSGENATE WITH AZIDE ION, by E. Lieber, C. B. Lawyer, and J. P. Trivedi. [1960] [3]p. incl. diagr. (AFOSR-TN-60-1065) [AF 49(638)474] Unclassified

Published in Jour. Org. Chem., v. 26: 1644-1646, May 1961.

Chlorothiatriazole was found to be the intermediate product in the preparation of 5-(substituted-amino)-1, 2, 3, 4-thiatriazoles from thiophosgene and NaN_3. However, 5-chlorothiatriazole, a low-melting oily solid (when preserved at 0°), proved to be too treacherous to handle, several preparations had given violent detonations of an unpredictable nature.

599

De Paul U. Dept. of Chemistry, Chicago, Ill.

THIATRIAZOLES AZIDO AND THIO GROUPS ATTACHED TO THE SAME CARBON ATOM, by E. Lieber and C. B. Lawyer. Final technical rept. Dec. 1, 1960, 108p. incl. diagrs. tables, refs. (AFOSR-TR-60-163) (AF 49(638)474) AD 248622 Unclassified

Studies were made of the chemical and physical properties of 5-(disubstituted)amino-1, 2, 3, 4-thiatriazoles. Comparisons are made with 5-amino and 5-(monosubstituted)thiatriazoles. Derivatives of the thiatriazole ring system were synthesized by (1) the reaction of nitrous acid with thiosemicarbazide and its 4-alkyl or 4-aryl substitution products, and (2) the reaction of aryl and alkyl isothiocyanates with hydrazoic acid. The objectives of this investigation were to examine synthetic routes to 5-(disubstituted)amino-1, 2, 3, 4-thiatriazoles and to study the variations in properties with changes in the nature of substituents in aminothiatriazole structure. A method for the study of the pyrolytic decomposition of the thiatriazoles was developed. From the data obtained comparisons were made relating the effects of substituents on the thiatriazole system. The relative order of stabilities decreased, in the following descending order: $(CH_3)2N$-; H_2N-; $(C_6H_5CH_2)_2N$; $(C_6H_5)HN$-; and $(CH_3)HN$-. Accordingly, the 5-(monosubstituted)amino-thiatriazoles appear less stable than the disubstituted ones. The compound 5-chloro-1, 2, 3, 4-thiatriazole (I) was synthesized by the reaction of thiophosgene and sodium azide. It was isolated at 0° and exploded violently when subjected to shock. (I) is soluble in most common organic solvents and insoluble in water. It decomposes generally around 5° with HCl evolution.

600

Detroit U. [Research Inst. of Science and Engineering] Mich.

ON THE TORSION OF A THIN-WALL CYLINDER FOLLOWING A PLASTIC EXTENSION, by H. Payne and S. J. Czyzak. [1960] [6]p. incl. tables. (AFOSR-TN-60-625) (AF 18(600)1466) Unclassified

Published in Jour. Mech. and Phys. Solids, v. 8: 39-44, Jan. 1960.

The problem of a thin-wall polycrystalline cylinder subjected to a torsional strain following a plastic tensile strain according to an extension of Taylor's theoretical model was investigated. Some agreement with experimental results was obtained.

601

Detroit U. [Research Inst. of Science and Engineering] Mich.

DEVELOPMENT OF A MATHEMATICAL THEORY OF PLASTICITY BASED ON THE CONCEPT OF SLIP III, by H. Payne, S. J. Czyzak and others. Sept. 1, 1960, 55p. incl. diagrs. tables, refs. (AFOSR-TR-60-107) (AF 18(600)1466) AD 242245; PB 150242 Unclassified

The work on the Mathematical Theory of Plasticity based on the concept of slip and the development of procedures for the investigation of the Bauschinger Effect are reviewed. Good agreement between theory and experiment concerning certain stress-strain relations is obtained. This justifies acceptance of the Taylor model which is discussed thoroughly.

602

Detroit U. [Research Inst. of Science and Engineering] Mich.

ON THE TENSILE STRESS-STRAIN RELATION AND THE BAUSCHINGER EFFECT FOR POLYCRYSTALLINE MATERIALS FROM TAYLOR'S MODEL, by S. J. Czyzak, N. Bow, and H. Payne. [1960] [4]p. incl. diagrs. tables. (AF 18(600)1466)
Unclassified

Published in Jour. Mech. and Phys. Solids, v. 9: 63-66, Feb. 1961.

An extension of Taylor's theoretical model was used to investigate the behavior of a polycrystalline material subjected to a fully plastic tensile strain first in one sense of displacement and then in the opposite sense. Some agreement with experimental results was obtained. (Contractor's abstract)

603

Directorate of Research Analysis. Holloman AFB, Alamagordo, N. Mex.

STUDIES ON THE PROBLEM OF MONITORING THE PLATFORM ATTITUDE OF A SLED BY OPTICAL MEANS, by G. Hughes and F. Allison. Dec. 1960, 23p. incl. diagrs. tables. (AFOSR-TR-60-149) AD 248542 Unclassified

Examination was made of several schemes, either proposed or currently under field test, for determining the orientation of a sled-carried platform in azimuth, pitch, and roll. Emphasis was placed on arrangements permitting a continuous monitoring of the attitude of the platform by optical means during the whole of the motion of the platform along the track. (Contractor's abstract)

604

Directorate of Research Analysis. Holloman AFB, Alamagordo, N. Mex.

ON THE USE OF A RADIOACTIVE SOURCE IN THE VELOCITY MEASURING SENSING HEAD ON A SLED ON THE HIGH-SPEED TRACK, by H. E. Carr and H. G. Hanson. Dec. 1960, 46p. incl. diagrs. tables, refs. (AFOSR-TR-60-150) AD 248579 Unclassified

Various radioactive sources and means of signal detection are considered for use in the velocity measuring sensing head now used in the space-time system at the Holloman track. Numerous advantages and limitations of such sources and detectors are considered. The most attractive possibility is the use of a 1-c γ-ray source in the 0.1-0.3 mev range. To obtain a detector which is suitably rugged yet sensitive, modest development costs will be required. To date the best choice is a solid state photo-detector with a luminescent crystal. Other detectors are too delicate or otherwise insufficiently developed at this time. A new method of space-time determination is proposed for use once the radioactive source technique is practicable. (Contractor's abstract)

605

Documentation, Inc. [Washington, D. C.]

AN EXTERNAL INDEX TO A COMPUTER STORE OF ITEMS AND TRANSACTIONS AS ILLUSTRATED BY PROJECT ECHO, by M. Taube. Dec. 1959 [18]p. incl. diagrs. tables. (AFOSR-TN-60-8) (AF 49(638)91) AD 231421; PB 145509 Unclassified

A combined data processing and information retrieval system designed to handle a changing store of information concerning a research and development contract program is described. The system was designed for the Air Force Office of Scientific Research. The concepts used in the design were generalized and made applicable to any information problem involving the storage and retrieval of changing sets of information. The concepts used in this analysis are the item, the transaction, and the index. After describing how the system operates with reference to AFOSR research and development contracts, the paper illustrates the operation of a similar system for the Cancer Chemotherapy National Service Center of the National Institutes of Health. In conclusion, the paper presents certain general conclusions relating to the man-machine problem of entering information, maintaining information, modifying information, and finally, removing information from a store. (Contractor's abstract)

606

Drexel Inst. of Tech. Lab. of Climatology, Centerton, N. J.

THE ROLE OF THE WATER BALANCE IN THE REDISTRIBUTION OF STRONTIUM IN THE SOIL. (Appendix I), by J. R. Mather. [1960] 13p. incl. diagrs. tables. (Technical note no. 1) (AFOSR-TN-60-97) (AF 49(638)409) AD 241891 Unclassified

Some of the results obtained on the water-Sr problem, i.e., determination of the quantity and seasonal distribution of water surplus at a place using the climatic water balance bookkeeping technique developed by Thornthwaite in 1948 and revised by Thornthwaite and Mather in 1955 are summarized. The movement of Sr through the soil, while slow, is directly influenced by the factors of the climatic water balance, especially the water surplus. The volume and composition of the leaching solution, and the cation exchange capacity of the soil, the two most influential factors controlling the movement of Sr are related to balance between the incoming moisture, the precipitation, and the outgoing moisture, the potential evapotranspiration at a place. Thus, knowledge of the water balance is basic to any understanding of the distribution of Sr both geographically and with depth in the soil.

607

Drexel Inst. of Tech. Lab. of Climatology, Centerton, N. J.

EQUATION AND TABLE FOR DETERMINATION OF THE WAVE OF LEACHING IN THE SOIL. (Appendix II), by C. W. Thornthwaite and S. Thornthwaite. [1960] [16]p. incl. tables. (Technical note no. 3) (AFOSR-TN-60-875) (AF 49(638)409) AD 241892
Unclassified

Also published in Centerton, N. J. Lab. of Climatology. Publications in Climatology, v. 13: 157-158, 1960.

Various leaching experimental results have indicated that there is an organized movement of the leachate downward in the soil in response to the application of a leaching solution such that a certain % of the original concentration moves downward to the next lower layer in the soil with each unit of water applied. The following equation, identical to the binomial distribution equation, is deduced: $X_n = \frac{t!}{(t-n)!\,n!} k^n(1-k)^{(t-n)}X_o$, where, X_n in the concentration in the n^{th} layer, n the receiving layer, t the cycle, k the fractional loss/cycle, and X_o the initial concentration of the substance in the source layer. The X_n values between t = 0 and 600 when k = 0.10 and $X_o = 10^4$ are tabulated. A summary table gives the values of the function for decadal values of t up to 500 and for even values of n.

608

Drexel Inst. of Tech. Lab. of Climatology, Centerton, N. J.

ANNOTATED BIBLIOGRAPHY ON PRECIPITATION CHEMISTRY. (Appendix III), by J. R. Mather. [1960] [58]p. incl. refs. (Technical note no. 2) (AFOSR-TN-60-876) (AF 49(638)409) AD 241893
Unclassified

Also published in Centerton, N. J. Lab. of Climatology. Publications in Climatology, v. 13: 97-154, 1960.

In the course of a research study on the climatic and hydrologic factors affecting the redistribution of Sr^{90} in the soil, it was found that the downward movement of Sr into the soil was controlled, in large measure, by the quantity of water available for leaching and the nature of the ion exchange reactions which occurred in the upper soil layers. A total of 147 papers published between 1855 and 1960 are included. A subject outline is given including bibliographies, conferences, major reviews, methods of sampling, methods of analysis, origin of constituents, relation with meteorologic and other factors, type of precipitation analyzed (other than rain water), and chemical constituents. A geographical outline and an author index are also given.

609

Drexel Inst. of Tech. Lab. of Climatology, Centerton, N. J.

THE CLIMATE AND HYDROLOGIC FACTORS AFFECTING THE REDISTRIBUTION OF Sr^{90}, by J. R. Mather and J. K. Nakamura. Final rept. June 1960, 18p. incl. diagrs. tables. (Technical rept. no. 1) (AFOSR-TR-60-101) (AF 49(638)409) AD 241890
Unclassified

From a laboratory experiment using different soils and leaching solutions, a mathematical model of leaching was set up which fairly well reproduced the leaching distribution measured in the laboratory. The rate of leaching was found to depend on the cation exchange capacity of the soil and the quantity and chemical composition of the leaching solution. The influence of climate on these 3 factors was studied. The climatic water balance provided a reasonable estimation of the quantity of surplus water or leaching solution which is available for redistributing strontium in the soil in any area. Using information on the climatic moisture index, defined as 100 (water surplus-water deficit) water need, and data on the cation exchange capacity of clay content of soils, the influence of climate on exchange capacity was studied. Comparison of measured and computed concentrations of strontium in the upper 2 in. of the soil at 5 sites, New York, Detroit, Seattle, Atlanta, and Albuquerque in different climatic regions provided a good evaluation of the usefulness of the mathematical model and gave an indication of the areal variation in leaching efficiency. Leaching is much more rapid, per unit of surplus water, in dry climates than in moist climates. The present studies are preliminary and need to be extended before any firm conclusions can be drawn. (Contractor's abstract, modified)

610

Drexel Inst. of Tech. Lab. of Climatology, Centerton, N. J.

MOVEMENT OF RADIOSTRONTIUM IN SOILS, by C. W. Thornthwaite, J. R. Mather, and J. K. Nakamura. [1960] [5]p. incl. diagrs. tables. (AF 49-(638)409)
Unclassified

Published in Science, v. 131: 1015-1019, Apr. 8, 1960.

Based on experimental results, it was possible to develop a mathematical model of movement in the soil which showed that a certain % of the Sr moved downward to the next lower layer of the soil for each unit volume of surplus water which is added to the layer. The practicability of this model depends on the following important factors: (1) the cation-exchange capacity of the soil both areally and with depth; (2) the quantity of surplus water available for leaching; (3) the initial Sr concentration in the soil and the increments to the soil due to fallout; (4) the chemical composition of the rain water and the soil solution; and (5) the leaching efficiency of various solutions containing cations and anions.

611

Dublin Inst. for Advanced Studies (Ireland).

THE SOLAR VARIATION IN RATE OF EXTENSIVE AIR SHOWERS, by C. B. A. McCusker, D. E. Page, and R. J. Reid. [1960] [6]p. incl. diagrs. tables, refs. [AF 61(514)164] Unclassified

Published in Proc. Internat'l. Conf. on Cosmic Rays, Moscow (USSR) (July 6-11, 1959), Moscow, v. 4: 281-286, 1960.

Variations in the rate of extensive air showers detected by apparatus selecting high electron densities by various experimental stations are reviewed. In the majority of cases, the variation is with solar time and seems to have components of 12 hr and 24 hr periods. It is suggested that the variation is due to a change in the structure of the shower with time and that this in turn is due to a change in the height of the first interaction. This is proved by further measurements of the electron density of these showers at 12 different distances from the detecting unit at all hours of the solar day. The suggested explanation of the variation in structure is that (a) many of the primary particles are heavy nuclei or (b) the interaction cross sections at these high energies are appreciably geater than geometric. Both of these hypotheses are possibly true and have been further investigated.

612

Dublin Inst. for Advanced Studies (Ireland).

[EXTENSIVE AIR SHOWERS, by C. B. A. McCusker]. Final rept. Dec. 1, 1958-Nov. 30, 1959 [11]p. incl. table, refs. (AFOSR-TR-60-12) (AF 61(052)163) AD 232089; PB 145678 Unclassified

The following effects were investigated: (a) the variation in rate of local penetrating showers of the cosmic radiation with solar time, (b) the variation in rate of dense extensive air showers with solar time, and (c) the variation in intensity over the sky of the primary particles causing extensive penetrating showers at sea level. In addition, considerable work was done on the structure of extensive air showers, the performance of directional arrays and the analysis of pressure variations produced by the atmospheric tides. (Contractor's abstract)

613

Duke U., Durham, N. C.

SYMPOSIUM ON ELECTRICAL CONDUCTIVITY IN ORGANIC SOLIDS, Duke University, Durham, N. C. (Apr. 20-22, 1960), ed. by H. Kallmann and M. Silver. New York, Interscience Publishers [1961] 398p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Office of Ordnance Research) Unclassified

The titles of 28 papers contributed by 44 authors are as follows: Charge-transport processes in organic materials (see item no. 1820, v. IV); Photoconductivity in aromatic hydrocarbon crystals; Photoelectric properties of semiconducting organic dyes; Observations on aromatic hydrocarbons with their electrical conductivity; The photoelectric behaviors of aromatic hydrocarbons; Pulsed photoconductivity in anthracene; The a-c and d-c photoconductivity in anthracene single crystals; Spatial distribution of trapped electrons in anthracene; Trapping centers and electronic conduction processes in anthracene and 9,10-dichloroanthracene; The diffusion of excitons and charges in molecular crystals; Molecular-orbital theory and crystals; Weak transitions in molecular crystals; Emission spectra in crystalline napthalene; Absorption and luminescence spectra and the spectral dependence of photoemission and photoconduction in aromatic hydrocarbon crystals; Paramagnetic resonance of phosphorescent napthalene molecules; Dispersion forces in molecular crystals; Electronic states of aromatic solids; Ionic organic photoconductors; The electrical conductivity of solid free radicals and the electron tunneling mechanism; The chemical aspects of semiconductive compounds; Photoconduction and photovoltaic effects in carotenoid pigments; Semiconductive properties of molecular complexes; Electric and magnetic properties of some low-resistance organic semiconductors; Electrical and thermal properties of poly-copper phthalocyanine; Long scintillation-decay times in anthracene; Biological aspects; Energy transfer by aqueous solutions of human serum-albumin (SAH); Photosensitized reactions; and The influence of electrode material on the photoconductivity in anthracene.

614

Duke U. [Dept. of Mathematics] Durham, N. C.

MIXED BOUNDARY VALUE PROBLEMS IN MATHEMATICAL PHYSICS, by I. N. Sneddon and F. J. Lockett. Jan. 4, 1960, 1v. incl. diagrs. tables, refs. (AFOSR-TN-60-51) (AF 18(600)1341) AD 231237 Unclassified

I. Some of the mixed boundary value problems which arise in mathematical physics are discussed: electrified discs, diffraction of electromagnetic radiation, problems in waveguide theory, diffusion problems, and electrostatic problems. II. Various techniques are presented for the solution of the electrified disk problem, including Weber's and Copson's solutions and the use of spheroidal coordinates. III. One tool which seems peculiar to the solution of mixed boundary value problems is the theory of dual integral equations. In this chapter the solution of such equations is considered, including dual equations with Hankel and trigonometrical kernels. IV. Some problems in electrostatics are analyzed by the methods developed in the preceding chapters. The "Classic" problem which is given most attention is the determination of the potential due to two parallel coaxial disks.

615

Duke U. [Dept. of Mathematics] Durham, N. C.

NUMERICAL VALUES OF SOME INTEGRALS INVOLVING BESSEL FUNCTIONS, by D. L. George. July 1960, 28p. (AFOSR-TN-60-982) (AF 18(600)-1341) AD 243143; PB 152066 Unclassified

Also published in Proc. Edinburgh Math. Soc., v. 13: 87-113, June 1962.

Analytic expressions are derived for integrals of the form: $S(v,n) = \int_0^\infty u^n \sin u\, J_v(ur)e^{-zu}du$ and $C(v,n) = \int_0^\infty u^{n-1}(1-\cos u)J_v(ur)e^{-zu}du$ where r and z are positive, and v and n are integers satisfying the convergence condition $v + n > -1$. Tables are presented of the numerical values of $S(v,n)$ and $C(v,n)$ for $v = 0$, $n = 0, 1$; and for $v = 1$, $n = -1, 0, 1$. The value of r, z ranges from 0 to 2 by steps of 0.1 and from 2 to 10 by unit steps.

616

Duke U. [Dept. of Mathematics] Durham, N. C.

THE PERTURBATION OF GROUP REPRESENTATIONS, by R. T. Harris, Jr. [July 1960] [9]p. incl. refs. (AFOSR-TN-60-983) (AF 18(600)1341) AD 243144; PB 152067 Unclassified

Also published in Duke Math. Jour., v. 28: 325-344, Sept. 1961.

An explicit method is given for the construction of unitary equivalences for unitary representations of abelian groups having scalar spectral measures absolutely continuous with respect to the Haar measure over the dual group. Questions of unitary equivalence are reduced to the study of a function K from the dual group to the bounded operators acting in an auxiliary Hilbert space D; for a particular character λ the range of K_λ may be regarded as the space of generalized eigenfunctions associated with λ. The vector-valued Fourier transform is used to translate perturbation hypotheses into statements about the functions K. The main result is contained in a theorem, where in conditions are given for unitary equivalence of perturbed and unperturbed representations. This result is applied to the case of an analytic perturbation. (Contractor's abstract)

617

Duke U. [Dept. of Mathematics] Durham, N. C.

A CLASS OF SOLUTIONS OF THE EQUATIONS OF THERMOELASTIC EQUILIBRIUM, by I. N. Sneddon. Aug. 1960 [11]p. (AFOSR-TN-60-1046) (AF 18(600)-1341) AD 243176; PB 152068 Unclassified

Also published in Arch. Mech. Stosowanej, v. 14: 113-125, 1962.

A class of boundary-value problems in the theory of elasticity requires that the tangential traction on some plane surface should be zero. It is shown that, with this restriction, the solution of the equation of thermoelastic equilibrium may be expressed in terms of three scalar potential functions. In the absence of a direct method of finding these potential functions for a particular problem, they must be found by an inverse method. In this way it is verified that certain chosen functions are suitable for the analysis of axially symmetric crack, punch, and thermal loading problems involving half-spaces, semi-infinite circular cylinders and elastic layers. Two-dimensional problems are also discussed.

618

Duke U. [Dept. of Mathematics] Durham, N. C.

BOUSSINESQ'S PROBLEM FOR A HEATED PUNCH. I. GENERAL THEORY, by D. L. George and I. N. Sneddon. Aug. 1960, 15p. incl. refs. (AFOSF.-TN-60-1047) (AF 18(600)1341) AD 243145 Unclassified

Also published in Jour. Math. and Mech., v. 11: 665-673, Sept. 1962.

The problem considered is the analysis of the stresses in a semi-infinite elastic body which is punched by a rigid solid of revolution. The punch, whose axis is normal to the boundary plane of the solid, is heated and so produces a non-uniform distribution of temperature on the free surface of the solid. The strains are assumed to be infinitesimal, and the equilibrium equations of the classical theory of elasticity are used. (Contractor's abstract)

619

Duke U. [Dept. of Mathematics] Durham, N. C.

STRESS IN THE VICINITY OF A CRACK IN A THICK ELASTIC PLATE, by M. Lowengrub. Nov. 1960 [16]p. incl. refs. (AFOSR-TN-60-1449) (AF 18(600)-1341) AD 249909; PB 154266 Unclassified

Also published in Quart. Appl. Math., v. 19: 119-126, July 1961.

The extension of Sneddon's [Proc. Roy Soc. (London), v. 187A: 229, 1946] method is considered for the case in which the thickness of the plate is T times the diam of the circular crack. It is assumed that the equations of the classical (infinitesimal) theory of elasticity hold. The boundary conditions appropriate to 2 types of problems are formulated. The problem is then reduced to the solution of a pair of dual integral equations which are solved by a procedure due to Lebedev and Uflyand [Jour. Appl. Math. and Mech., v. 22: 422, 1958]. Exact analytical expressions are derived for the solution only in the case of large values of T. The procedure to be followed in a numerical discussion of the solution is illustrated by the calculation of the shape of the deformed crack. (Contractor's abstract)

620

Duke U. Medical Center, Durham, N. C.

PSYCHOPHYSIOLOGICAL INVESTIGATIONS IN SENSORY DEPRIVATION. THE BODY-FIELD DIMENSION, by A. J. Silverman, S. I. Cohen and others. [1960] [15]p. incl. diagr. tables, refs. (AFOSR-TN-60-742) (AF 49(638)354) Unclassified

Presented at annual meeting of the Psychosomatic Soc., Montreal (Canada), Mar. 26, 1960.

Published in Psychosomat. Med., v. 23: 48-62, Jan. - Feb. 1961.

It was postulated that subjects who rely more on external rather than internal cues would react differently to an experience in which external cues were lacking. Using the Draw-a-Person test and the Rod and Frame test on a population of 109 college students to determine extent of Field dependency, 5 Body and 6 Field subjects were selected and placed in a low-sensory environment for 2 hr. Field-dependent subjects performed more poorly on pre- and post-experimental two-point discrimination and letter identification, remained more aroused (GSR, EEG), and tended to move around more. Post-experimentally they expressed more discomfort about the experiment, struggled more with feelings and fantasies (or denied them), were more suspicious, and projected internal precepts more. Other trends noted were a general decrease in arousal (GSR, EEG, pulse rate for all subjects over the 2 hr and a direct correlation between amount of movement and verbalization artifact, GSR and discomfort, between ego organization and sensory discrimination, adrenaline level and discomfort, and adrenaline level and pulse rate. (Contractor's abstract)

621

Duke U. Medical Center, Durham, N. C.

URINARY CATECHOL AMINE LEVELS, GASTRIC SECRETION AND SPECIFIC PSYCHOLOGICAL FACTORS IN ULCER AND NON-ULCER PATIENTS, by S. I. Cohen, A. J. Silverman and others. [1960] [54]p. incl. diagrs. tables, refs. (AFOSR-TN-60-743) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)354, Massachusetts General Hospital under AF 49(638)98, and Public Health Service) Unclassified

Presented at annual meeting of the Amer. Psychiat. Assoc., Atlantic City, N. J., May 13-14, 1960.

Also published in Jour. Psychosomat. Research, v. 5: 90-115, Feb. 1961.

Gastric secretory studies and urinary assays for catechol amines were carried out on 10 patients with radiologically proven ulcers and 10 non-ulcer patients. A group of psychological tests and a specially constructed interview were administered. The patients whose psychological measures were scored (without any knowledge of clinical diagnosis, gastric secretion and urinary catechol amine levels) as demonstrating a high degree of anxiety and a low level of or a discomfort with the expression of aggressive impulses were noted as being most likely to have a low noradrenaline output, and a duodenal ulcer. The psychological measures discriminated ulcer and non-ulcer patients at a 0.01 level of confidence. Noradrenaline levels were lower in ulcer than non-ulcer patients. The results reconfirmed the correlations previously noted in the following 3 types of studies: (1) The levels of adrenaline and noradrenaline excreted in a patient's urine correlates with the degree of aggresivity and anxiety expressed on specific psychological test measures. (2) Specific psychological characteristics can discriminate ulcer and non-ulcer patients. (3) The ratio and level of urinary catechol amines may be a reflection of autonomic imbalance and is associated with duodenal ulcers. (Contractor's abstract)

622

Duke U. Medical Center, Durham, N. C.

CATECHOL AMINES IN PSYCHOPHYSIOLOGICAL STUDIES, by A. J. Silverman, S. I. Cohen and others. [1960] [33]p. incl. diagrs. tables, refs. (AFOSR-TN-60-796) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)354, Duke U. Center for the Study of Aging, National Institute of Mental Health, and National Institutes of Health) Unclassified

Presented at Fifteenth annual Convention and Scientific Program of the Soc. of Biol. Psychiat., Miami Beach, Fla., June 7, 1960.

Also published in Recent Advances in Biol. Psychiat., v. 3: 104-118, 1961.

Psychomotor activity changes are associated with catechol amine changes. When psychomotor activity is carefully controlled, it can be demonstrated that different affects are associated with the differential excretion of adrenaline and noradrenaline. In some subjects, however, these relationships are not found. Because of the multiple factors involved which play a role in catechol amine excretion such as activity, affect, cardiovascular status, hypothalamic responsivity, as well as the relationship to other endogenous substances, it is concluded that in order to be able to evaluate the psychophysiologic implications of the catechol amines, multiparameter investigations are needed which can include the control and/or assessment of the factors which have been listed above. (Contractor's abstract)

623

Duke U. Medical Center, Durham, N. C.

PSYCHOPHYSIOLOGICAL MECHANISMS OF STRESS RESPONSIVITY, by S. I. Cohen, A. J. Silverman, and B. M. Shmavonian. Second annual rept. Apr. 1959-Apr. 1960 [98]p. incl. tables. (AFOSR-TN-60-1178) (AF 49(638)354) PB 155776 Unclassified

This report is given in 6 sections. (1) Introduction. (2) Summary of psychophysiological responses to a

"low sensory input" environment: Introductory comments; physiological and endocrinological measures; psychological measures; relationship of catechol amine levels and vascular indices; catechol amine levels and psychological indices; relationship of catechol amine levels, psychological discomfort and central nervous system activity; relationship between nonspecific skin resistance changes, adrenaline levels and peripheral vascular activity; and discussion. (3) The development of a "predictive" psychological test battery: Psychological survey of Air Force R. O. T. C. subject population; and relationship of psychological and endocrinological variables to the response to an isolated, low sensory input experimental environment. (4) Remarks on general significance of research to the Air Force. (5) Summary of research completed, in progress, and plans for the future. (6) Activities of the staff of the Division of Psychophysiological Research. Test results are tabulated and given in the appendix.

624

Duke U. Medical Center, Durham, N. C.

PSYCHOPHYSIOLOGICAL MECHANISMS OF STRESS RESPONSIVITY, by S. I. Cohen, A. J. Silverman, and B. M. Shmavonlan. Semi-annual rept. Apr. 1960-Oct. 1960, 28p. incl. table. (AFOSR-TN-60-1356) (AF 49(638)354) AD 245460; PB 152837
Unclassified

An attempt is made to delineate personality variables which might be associated with a differential impact that the sensory deprivation situation will have on the individual subjects. The data which was analyzed on the total group of subjects tested for Body and Field orientation in relation to differences the two groups showed in the psychological, neurophysiological, endocrinologic and physiologic responses to the specific experimental situation is described. (Contractor's abstract)

625

Duke U. [Microwave Lab.] Durham, N. C.

DIELECTRIC RELAXATION OF DILUTE SOLUTIONS IN THE MILLIMETER WAVE REGION, by J. Schneider. [1960] [15]p. incl. diagrs. tables. (AFOSR-TN-60-90) (Bound with its Quarterly progress rept. no. 28, Nov. 1, 1959-Feb. 1, 1960) [AF 18(600)497] Unclassified

Also published in Jour. Chem. Phys., v. 32: 665-668, Mar. 1960.

The dielectric losses of benzophenone, diphenylether, diphenylamine, chlorobenzene and aniline, measured at 12.33, 6.19, 3.08 and 2.47 mm wavelength in dilute benzene solutions, have been found to fit Debye type relaxation curves within the limits of experimental error. The distinctly lower relaxation time of diphenylether and of diphenylamine, compared to the one for benzophenone, can be explained by a high internal mobility of the phenyl rings in these 2 molecules. Similarly, the mobility of the amino group in aniline results in a decrease of the relaxation time, compared to the rigid chlorobenzene molecule. (Contractor's abstract).

626

Duke U. [Microwave Lab.] Durham, N. C.

CENTRIFUGAL EFFECTS IN MILLIMETRE WAVE SPECTRA: FORMYL FLUORIDE, by P. [G.] Favero, A. M. Mirri, and J. G. Baker. [1960] [18]p. incl. tables, refs. (AFOSR-TN-60-486) (AF 18(600)497)
Unclassified

Also published in Nuovo Cimento, Series X, v. 17: 740-748, Sept. 1, 1960.

The 3 rotational and 6 distortion constants of both formyl and d-formyl fluoride were determined from their millimeter wave absorption spectra, using an improved method of calculation of centrifugal effects. The rotational constants are: for HCOF, A = 91,156.56 mcs., B = 11,760.23 mcs., C = 10,396.72 mcs; for DCOF, A = 65,096.59 mcs, B = 11,761.74 mcs, C = 9,941.71 mcs. Taken with electron diffraction data these yield the parameters r_{CH} = (1.087 ± 0.01)A, r_{CO} = (1.182 ± 0.003)A, r_{CF} = (1.341 ± 0.003)A, and β_{FCO} = (123.04 ± 0.02). Comparisons are made with structure of the formyl grouping in similar molecules. It is concluded that it is not safe to neglect centrifugal effects even for low J transitions. The molecular parameters obtained are in good agreement with those of earlier workers, and show that the formyl grouping undergoes large changes even in the simplest formyl compounds. (Contractor's abstract)

627

Duke U. Microwave Lab., Durham, N. C.

OBSERVATION OF A π STARK COMPONENTS IN MICROWAVE SPECTROSCOPY: PRECISION MEASUREMENTS ON HCN, by B. N. Bhattacharya and W. Gordy. [1960] [25]p. incl. diagrs. tables. (AFOSR-TN-60-535) (Bound with its Quarterly progress rept. no. 29, Feb. 1, 1960-May 1, 1960) (AF 18(600)497)
Unclassified

Also published in Phys. Rev., v. 119: 144-149, July 1, 1960.

A parallel plate Stark cell has been designed and constructed for the millimeter wave region of the spectrum. With the cell both π and σ Stark components can be observed. High precision Stark effect measurements have been made on the π and σ components of the J = 0 → 1 transition of HCN^{14}. From these the electric dipole moment of HCN in the ground vibrational state has been calculated to be 2.985 ± 0.005 Debye units. (Contractor's abstract)

628

Duke U. [Microwave Lab.] Durham, N. C.

ANOMALOUS STARK EFFECTS IN THE MILLIMETRE WAVE SPECTRUM OF FORMYL FLUORIDE, by P. [G.] Favero and J. G. Baker. [1960] [12]p. incl. diagrs. tables. (AFOSR-TN-60-536) (AF 18(600)497) AD 254998 Unclassified

Also published in Nuovo Cimento, Series X, v. 17: 734-739, Sept. 1, 1960.

Measurements of Stark effects in the rotational spectra of formyl and d-formyl fluoride show the presence of anomalous components that vary in strength with the field. They occur predominantly at high fields and may possibly be a molecular polarizability effect. In addition the normal molecular dipole moment is found to be (1.99 ± 0.03)D, orientated almost parallel to the C-H bond and at an angle of 79° to the C-F bond. This is discussed in connection with the molecular structure. (Contractor's abstract)

629

Duke U. [Microwave Lab.] Durham, N. C.

ELECTRON PARAMAGNETIC RESONANCE STUDIES OF CYTOCHROME AND HEMOGLOBIN (IRRADIATED AND UNIRRADIATED), by W. Gordy and H. N. Rexroad. [1960] [34]p. incl. diagrs. refs. (AFOSR-TN-60-580) (Bound with its Quarterly progress rept. no. 29, Feb. 1-May 1, 1960) (AF 18(600)497) Unclassified

Also published in Proc. Symposium on Free Radicals in Biological Systems, Stanford U., Calif. (Mar. 21-23, 1960), New York, Academic Press, 1961, p. 263-277.

Paramagnetic resonance of methemoglobin derived from human blood of types AA, CC, and SS was observed at 2900 mc/sec. Under unirradiated conditions the resonance of acid methemoglobin differs from that of cytochrome c and ferrihemoglobin azide indicating an ionic type bonding for the former and covalent bonding for the latter two. Both hemoglobin and cytochrome c, when exposed to nitric oxide, give similar results indicating that the electron spin density is concentrated on the NO in the hemoglobin- and cytochrome-NO complexes. This further suggests that if the NO is attached to the Fe ion to form the complexes, it is not bonded through a covalent bond formed by the sharing of its odd electron with one on the Fe ion. Types AA, CC, SS, F (fetal) hemoglobin and cytochrome c were also exposed to X and γ radiations. When exposed to oxygen all give a singlet resonance several gauss in width; however, radiation within a vacuum results in a doublet resonance for all except F hemoglobin which continues to give a broad singlet. When oxygen is reintroduced to the samples the doublet converts to a singlet resonance. The conclusions drawn are that the F hemoglobin's higher affinity for oxygen is sufficient to prevent the oxygen deprivation state. Furthermore the width and shape of the doublet resonance indicate that it arises from a spin density located on the globin protein sufficiently removed from the heme ring that no significant magnetic interaction occurs between this spin density and that on the Fe ion or bonded NO.

630

Duke U. [Microwave Lab.] Durham, N. C.

A PROPOSED MOLECULAR AMPLIFIER AND COHERENT GENERATOR FOR MILLIMETER AND SUBMILLIMETER WAVES, by W. Gordy and M. [J.] Cowan. [1960] 7p. incl. diagr. (AFOSR-TN-60-581) (Bound with its Quarterly progress rept. no. 29, Feb. 1-May 1, 1960) (AF 18(600)497) Unclassified

Also published in Jour. Appl. Phys., v. 31: 941-942, May 1960.

A method of obtaining effective state selection in ammonia maser type devices at submillimeter wavelengths is suggested. If a collimated beam of symmetric-top molecules is passed through an electric field gradient, the $M \neq 0$ states are scattered out of the beam leaving only $M = 0$ states focused into the cavity. If a homogenous Stark or Zeeman field is now applied to the molecules in such a way that $M = \pm 1$ transitions are stimulated, population inversion can be achieved and stimulated emission can occur between the $J + 1$, K, $M = 0$, and the J, K, $M = \pm 1$ levels.

631

Duke U. Microwave Lab., Durham, N. C.

STRUCTURE AND ORIENTATION OF FREE RADICALS FORMED BY IONIZING RADIATIONS IN CERTAIN NATIVE PROTEINS, by W. Gordy and H. Shields. [1960] [38]p. incl. diagrs. refs. (AFOSR-TN-60-1249) (Bound with its Quarterly progress rept. no. 30, May 1, 1960-Aug. 1, 1960; AD 247412) (AF 18(600)497) AD 247412(a) Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 46: 1124-1136, Aug. 1960.

Silk and feather quill were investigated by the electron spin resonance method while being irradiated by ionizing radiation. In some cases, the structure and orientation of the resulting free radicals showed that this method can give information about the structure of the protein which supplements that obtained from x-ray diffraction and infrared studies. In this study the resonance characteristic of polycrystalline cystine is observed in the irradiated hair and feather quill for all orientations of the axis of the hair fiber or quill in the static magnetic field. It is suggested that this indicates that the C-S or S-S bonds are polyoriented in these substances.

632

Duke U. Microwave Lab., Durham, N. C.

TEMPERATURE EFFECTS OF FREE RADICAL

FORMATION AND ELECTRON MIGRATION IN IRRADIATED PROTEINS, by F. Patten and W. Gordy. [1960] [24]p. incl. diagrs (AFOSR-TN-60-1250) (Bound with its Quarterly progress rept. no. 30, May 1, 1960-Aug. 1, 19[illegible], AD 247412) (AF 18(600)-497) AD 247412(b) Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 46: 1137-1144, Aug. 1960.

The electron spin resonance patterns of glycine and silk, casein and pepsin, acetyl glycine, L-cysteine and toe-nail, DL-cystine and bovine albumin and steer's horn were observed at 77°K and 300°K. Co^{60} γ-irradiation was performed at 77°K. The resonance pattern at 77°K after irradiation is wide and unspecific and consistent with the expected random distribution of electron vacancies and negative charges induced by the irradiation in the protein molecule. On warming to 300°K this pattern changes irreversibly into one recognizably belonging to a free radical at α-C atom of a peptide backbone or at the S atom of cysteine. It is concluded that the vacancies and negative charges are able to migrate in the molecule at 300°K, but are almost immobile at 77°K. An exception is acetyl glycine. The doublet characteristics at room temperature is produced by irradiation at 77°K without warming, suggesting that the unpaired electron of the ionized molecule is in a π orbital. Mechanisms for the formation of the characteristic free radicals seen at room temperature from those observed at 77°K are suggested.

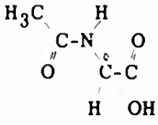
633

Duke U. Microwave Lab., Durham, N. C.

ELECTRON SPIN RESONANCE OF AN IRRADIATED SINGLE CRYSTAL OF N-ACETYLGLYCINE, by I. Miyagawa, Y. Kurita, and W. Gordy. [1960] [22]p. incl. diagrs. (AFOSR-TN-60-1251) (Bound with its Quarterly progress rept. no. 30, May 1, 1960-Aug. 1, 1960; AD 247412) (AF 18(600)497) AD 247412(c); AD 250647 Unclassified

Also published in Jour. Chem. Phys., v. 33: 1599-1606, Dec. 1960.

Electron spin resonance absorption of an irradiated single crystal of N-acetylglycine was observed at room temperature at 9 kmc and 12 kmc. From the analysis of the anisotropy in the spectroscopic splitting factor and in the nuclear hyperfine interaction constant, a chemical structure



is deduced for the free radical. The C-H bond is in the NCC plane and approximately along the bisector of the NCC angle. The unpaired electron spin density is essentially in a π orbital, about 72% of which is in p orbital of the CH carbon directed perpendicular to the NCC plane. (Contractor's abstract)

634

Duke U. Microwave Lab., Durham, N. C.

[PARAMAGNETIC ELECTRON SPIN AND MICROWAVE SPECTROSCOPY], by [W. Gordy]. Final rept. Sept. 30, 1960 [9]p. incl. refs. (AFOSR-618) (AF 18(600)497) Unclassified

A bibliography of 91 papers published between 1953 and 1961 under this contract are listed.

635

Duke U. [Microwave Lab.] Durham, N. C.

MEASUREMENTS OF FREE ELECTRONS IN FLAMES, by J. Schneider, F. W. Hofmann, and H. Kohn. [1960] [5]p. incl. diagr. (Bound with its Quarterly progress rept. no. 28, Nov. 1, 1959-Feb. 1, 1960) [AF 18(600)497] Unclassified

As in the case of Na, the microwave attenuation measurements in the vapors of heavy alkali elements, K, Rb, and Cs, were carried out with 11 wavelengths ranging between 3 and 12 mm and widely varied concentrations of the aqueous metal salt solutions introduced into the flame. The concentrations ranged between 10^{-4} and 1 M. Accordingly, the attenuation values $\beta/d = 20 \log_{10} (Po/P)/d$ ranged between 0.1 and 20 db/cm, and the rigorous equations: $n' = 1/\sqrt{2}\ (\sqrt{(1+\beta)^2+\alpha^2} + 1 + \beta)^{1/2}$ and $n'' = 1/\sqrt{2}\ (\sqrt{(1+\beta)^2+\alpha^2} - 1 - \beta)^{1/2}$, where $\alpha = 4\pi\sigma'/\omega$, and $\beta = 4\pi\sigma''/\omega$, had to be applied to calculate the corresponding electron densities N and electron partial pressures p_e. The value of the electron-molecule collision frequency $\nu = 26 \times 10^{10}\ sec^{-1}$ gained from the investigation of Na vapor was used for the evaluation of N and p_e. The exact relationship between β/d and N can conveniently be written as $N = 2.169\nu\,(1 + \omega^2/\nu^2)\beta/d\,[(1 + (1 + \omega^2/\nu^2)n''^2)^{1/2} - (\omega/\nu)n'']$ where $n'' = 3.452 \times 10^9\ \beta/\omega d$. The results are consistent for all wavelengths applied. In spite of certain deviations which are mentioned, the results of these investigations may be considered a good quantitative verification of the Saha equation. They are of considerable significance for studies of total line intensities at low vapor densities where the heavy alkali atoms are largely ionized.

636

Duke U. [Microwave Lab.] Durham, N. C.

MILLIMETER AND SUBMILLIMETER WAVES IN PHYSICS, by W. Gordy. [1960] [47]p. incl. illus. diagrs. tables, refs. (Bound with its Quarterly progress rept. no. 28, Nov. 1, 1959-Feb. 1, 1960) [AF 18(600)497] Unclassified

Also published in Proc. Symposium on Millimeter Waves, New York, N. Y. (Mar. 31-Apr. 2, 1959), New York, Polytechnic Inst. of Brooklyn Press [1960] p. 1-23.

This paper reviews research undertaken in the following areas: (1) Detection of millimeter and submillimeter radiation. The spark-gap era; (2) Development of millimeter and submillimeter wave spectroscopy; and (3) Types of measurement which can be made with millimeter and submillimeter waves. There are 48 domestic and foreign references cited covering a time period from 1895-1959.

637

Duke U. [Microwave Lab.] Durham, N. C.

DEUTERIUM SUBSTITUTION IN THE STUDY OF RADIATION INDUCED ORGANIC FREE RADICALS (Abstract), by W. Gordy and I. Miyagawa. [1960] [1]p. [AF 18(600)497] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 227, Apr. 25, 1960.

By repeated treatment with D_2O at ordinary temperatures, the hydrogens of amino or hydroxyl groups in most organic and biochemicals can be replaced by deuterium without a corresponding replacement of the hydrogens bonded to carbon. Since D and H have different nuclear moments, one can, with this treatment, learn whether the amino or hydroxyl hydrogens form a part of the free radicals produced by irradiation of the substance. This method has been used to investigate most of the amino acids, several proteins, and a number of carboxylic acids and amides. Generally, it was found that the labile hydrogens which could be substituted by D_2O treatment do not give an observable hyperfine structure, and thus one can infer that the often observed proton hyperfine structure of the resonance usually arises from hydrocarbon groups in the radicals. A notable exception among the amino acids is glycine, the pattern of which is significantly changed by D_2O treatment. Interestingly, the doublet structure observed for glycylglycine and certain proteins - silk, albumin, pepsin, etc., is not changed by D_2O treatment. This indicates that the doublet arises from a proton bonded to carbon.

638

Duke U. [Microwave Lab.] Durham, N. C.

CENTRIFUGAL DISTORTION AND VIBRATION-ROTATION EFFECTS IN ASYMMETRIC ROTORS (Abstract), by J. G. Baker. [1960] [1]p. [AF 18(600)-497] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 241, Apr. 25, 1960.

The following formula is shown to describe centrifugal distortion in the rotational energy levels of any asymmetric top molecule with high accuracy: $\Delta W_{cent} = -(D_J + 1/2\, b\, R_{10})J^2(J+1)^2 - (D_{JK} - b\,R_{10})J(J+1)(w - b\frac{dw}{db}) + 2\,\delta_J\, J(J+1)\frac{dw}{db} - (D_k + 1/2\, b R_{10})(w^2 - bw\frac{dw}{db}) + R_{10}\, w\frac{dw}{db}$ + standard correction terms in $(R_b + 1/4\, b R_{10})$ w is the conventional "reduced energy" taking the value of K^2 in the symmetric top limit, and b the Wang asymmetry parameter. All other constants have been defined by Nielsen with the exception of R_{10}, which has the value $(bD_k + 4D_5)/(1-1/2\, b^2)$. This formula has been applied to the millimeter wave spectra of formyl fluoride and formic acid and the constants obtained used to estimate the inertial shifts due to zero point vibration and to obtain better values for the molecular parameters.

639

Duke U. [Microwave Lab.] Durham, N. C.

MILLIMETER AND SUBMILLIMETER WAVE SPECTROSCOPY: EVALUATION OF CENTRIFUGAL DISTORTION EFFECTS IN BrCN AND NF_3 (Abstract), by M. [J.] Cowan and W. Gordy. [1960] [1]p. [AF 18(600)-497] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 241, Apr. 25, 1960.

Submillimeter wave transitions in $Br^{81}CN$ were measured at 392, 907.0 ± mc/sec (J = 47 → 48), at 425,575.9 ± 0.9 mc/sec (J = 51 → 52), and at 458,226.2 ± 0.9 mc/sec (J = 55 → 56). These, with the millimeter wave transitions measured earlier (item no. DUK. 03:056, Vol. I), were found to fit the frequency equation, $\nu = 2B(J+1) - 4D(J+1)^3 + 2H(J+1)^3(2J^2 + 6J + 4)$, with the values B = 5096.808 mc/sec, $D = 8.716 \times 10^{-4}$ mc/sec, and $H = -7 \times 10^{-10}$ mc/sec. This represents the first measurement of the higher order stretching constant H in microwave spectroscopy. Less accurate measurements have been made on transitions of BrCN up to 589 kmc/sec or 0.509-mm wavelength. From measurements of transitions of NF_3 in the shorter millimeter wave region the values: B_0 = 10,680.45 mc/sec, D_J + 0.0095 mc/sec, D_{JK} = -0.022 mc/sec, and $eQq(N^{14})$ = -7.09 mc/sec. The values of D_J and D_{JK} differ significantly from the earlier rough values obtained from lower J transitions but agree well with values estimated by Schatz from vibrational force constants.

640

Duke U. [Microwave Lab.] Durham, N. C.

MOLECULAR QUADRUPOLE MOMENT OF NITRIC OXIDE, by D. V. G. L. Narasimha Rao. [1960] [2]p. [AF 18(600)497] Unclassified

Published in Nature, v. 186: 881-882, June 11, 1961.

The molecular quadrupole moment is calculated to be 1.57 ea_H^2 against the experimental value of 1.01 ea_H^2, where a_H denotes the Bohr radius and e the electronic charge, in a molecular orbital approximation. The calculation is made under assumptions that (1) the mass center of the system is located at the midpoint of the internuclear line NO; (2) the N-O bond is of a pure covalent type with no hybridization on N or O atoms; (3) the molecular orbitals are represented by combinations of Slater type atomic orbitals with suitable screening constants for N and O; and (4) the exchange quadrupole contributions are negligible.

641

Duke U. [Microwave Lab.] Durham, N. C.

ELECTRON SPIN RESONANCE IN A GAMMA-IRRADIATED SINGLE CRYSTAL OF L-CYSTINE DIHYDROCHLORIDE, by Y. Kurita and W. Gordy. [1960] 7]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)497] and Office of Ordnance Research) AD 261576 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 253, Apr. 25, 1960.

Also published in Jour. Chem. Phys., v. 34: 282-283, Jan. 1961.

The electron spin resonance of a gamma -irradiated single crystal of L-cystine dihydrochloride, HOOC-CH(NH_2)-CH_2-S-S-CH_2-CH(NH_2)-COOH-2HCl, has been measured at 9 kmc/sec and at 24 kmc/sec for various orientations of the crystal in the magnetic field. The resonance pattern was found to be a doublet, the spacing between the components of which is independent of the crystal orientation as well as of the strength of the static magnetic field. The spectroscopic splitting factor was found to be anisotropic with the principle values: $g_u = 2.003$, $g_v = 2.025$, and $g_w = 2.053$. A model of the free radical, HOOC-CH(NH_2)-CH_2-S·, in which the electron spin density is mainly concentrated in a nonbonding 3p orbital of the sulfur atom, is proposed. The model accounts very well for the principal values of the g tensor as well as their directions relative to the atomic configuration. It also can give rise to the observed proton hyperfine structure. (Contractor's abstract)

642

Duke U. Microwave Lab., Durham, N. C.

ELECTRON SPIN RESONANCE IN A GAMMA-IRRADIATED SINGLE CRYSTAL OF THIODIGLYCOLIC ACID, by Y. Kurita and W. Gordy. [34]p. incl. diagrs. table, refs. (Technical rept. no. 31) (AFOSR-624) (AF 49(638)765) AD 254585 Unclassified

Also published in Jour. Chem. Phys., v. 34: 1285-1291, Apr. 1961.

The ESR of a γ-irradiated single crystal of thiodiglycolic acid was measured at room temperature at 9 kmc/sec. From the analysis of the anisotropy in the spectroscopic splitting factor and in the nuclear hyperfine interaction constants, a model of the free radical, HOOC-CH_2-S-CH-COOH, is proposed. In this free radical, the electron spin density is mainly in a π-orbital, about 60% of which is the p-orbital of the CH carbon, 2% is the 1s-orbitals of the CH_2 hydrogens, and 22% is in the p-orbital of the S. (Contractor's abstract)

643

Duke U. [Microwave Lab.] Durham, N. C.

MILLIMETRE WAVE SPECTRUM OF DEUTERO-DERIVATIVES OF FORMIC ACID, by A. M. Mirri. [1960] [6]p. incl. tables. [AF 49(638)765] Unclassified

Published in Nuovo Cimento, Series X, v. 18: 849-855, Dec. 1, 1960.

The rotational constant A of DCOOH, HCOOD and DCOOD have been determined by analyzing the ⟨a⟩ type transitions in the range of frequencies from (1.2×10^5) mcs to (1.6×10^5) mcs. By assuming I_a and I_b as the equilibrium moments of inertia, the Kraitchman's method has been used to determine the coordinates of the 2 hydrogen atoms in the principal axis system of HCOOH. The centrifugal distortion constants of the 3 molecules are also given. (Contractor's abstract)

644

Eastern Research Group, [Brooklyn] N. Y.

JET DEFLECTION FOR STUDIES ON AIRCRAFT CONTROL AND EXTERNAL FLOW INTERACTION, by L. Meyerhoff. Nov. 1960, iv. incl. diagrs. tables, refs. (AFOSR-TR-60-178) (AF 18(600)1530)
Unclassified

A model for deflecting a large mass flow propulsive jet at hypersonic airspeeds is described. It is desinged to obtain basic data on jet deflection flow patterns and forces in interaction with an external airstream. Model detail configuration is shown including strain gage balances for measuring axial, side forces, and moments. Air supply for the jet is shown as well as the means to avoid internal reaction forces from interfering with strain gage reading. Stress analysis of the model is given. Jets can be deflected through a wide angular range from directly aft to about 150° forward. The final design is based on the requirements of the revised (2 x 2) ft supersonic tunnel at Wright Field. A general analysis is given of jet forces and mass flows pertinent to jet issuing models. Certain existing jet deflection test data are analyzed and compared. (Contractor's abstract)

645

Edinburgh U. Dept. of Pharmacology (Gt. Brit.).

THE ACTION OF DRUGS ON THE NORADRENALINE CONTENT OF BRAIN AND SYMPATHETIC GANGLIA, by S. Sanan and M. Vogt. Aug. 15, 1960 [14]p. incl. tables. (Technical rept. no. 1) (AFOSR-TN-60-1286) (AF 61(052)277) AD 247171; PB 155531
Unclassified

Dimethylphenylpiperazinium iodide, given at frequent intervals intravenously to rabbits (total dose during 4 hr. period 3.5-11.1 mg/kg), often but not invariably lowered the concentration of noradrenaline in the superior carvical ganglia. 10-Methoxydeserpidine and guanethidine depleted peripheral sympathetic ganglia of their noradrenaline in cats and rabbits; hypothalamic noradrenaline remained unchanged in the rabbit but fell in the cat. Repeated doses of the amine oxidase inhibitors amphetamine hydrazine and phenylhydrazinobutane increased the noradrenaline content of the brain but behavioral effects were small and not related to the level of noradrenaline produced by the drug. (Contractor's abstract)

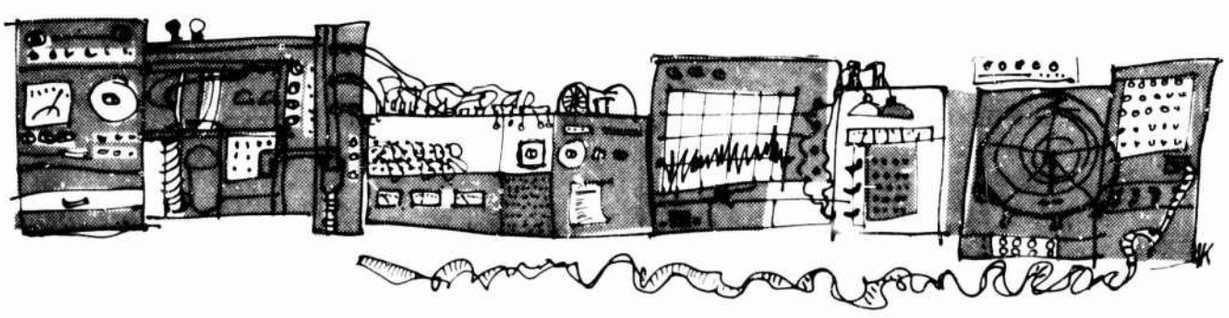
646

Electrochemical Soc. Theoretical Electrochemistry Div., New York.

TRANSACTIONS OF THE SYMPOSIUM ON ELECTRODE PROCESSES, Philadelphia, Pa. (May 4-6, 1959), ed. by P. Delahay. New York, John Wiley & Sons. [1961] 374p. incl. illus. tables, diagrs. refs. [AF 49(638)534]
Unclassified

A total of 18 papers are included. The following areas are covered: (1) Double layer phenomena and correlation with electrode processes; (2) metal deposition and dissolution; and (3) fast electrode reactions. Also, transposition of methods of chemistry to electrochemistry is discussed in 2 papers. The discussions recorded during the symposium are included. An author and subject indicies are also given.

Enrico Fermi Inst. for Nuclear Studies, Chicago Ill.
see Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.



647

Fairchild Engine and [Airplane] Corp. Fairchild Engine Div., Deer Park, N. Y.

A STUDY OF SUPERSONIC COMBUSTION, by R. A. Gross and W. Chinitz. [1960] [9]p. incl. illus. diagrs. refs. (AF 49(638)15) Unclassified

Published in Jour. Aero/Space Sci., v. 27: 517-525, July 1960.

Steady, stable, plain, and oblique detonation waves were created in a high-temperature, steady flow supersonic tunnel. Ignition conditions and properties across the wave were measured. The local-wave fluid-dynamic properties agree well with detonation theory. Experimental data are presented in detail and compared with other studies and theory. Experimental behavior of these detonations and their possible utility are discussed. (Contractor's abstract)

648

Federation of American Societies for Experimental Biology, Washington, D. C.

PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON COLD ACCLIMATION, Buenos Aires (Argentina), August 5-7, 1959, ed. by R. E. Smith. 1960. 165p. incl. illus. diagrs. tables, refs. (AFOSR-386) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)607] Army Quartermaster Research and Engineering Command, Burroughs Wellcome and Co., Inc., Federation of American Societies for Experimental Biology, Instituto Antartico Argentino, National Science Foundation, and Office of Naval Research) AD 614146 Unclassified

Also published in Fed. Proc., v. 19: 1-165, Dec. 1960.

This report represents a collection of several papers dealing with human reactions to low temperature climates. Some topics discussed are thermogenesis in the acclimated animal, neurohumoral response patterns and endocrine functions, intermediary metabolism, and cellular and subcellular energetics.

649

Florida State U. Dept. of Chemistry, Tallahassee.

ENERGY TRANSFER IN MOLECULAR COMPLEXES. II. THE ANTHRACENE-SYM-TRINITROBENZENE COMPLEX, by S. P. McGlynn, J. D. Boggus, and E. Elder. [1959] [5]p. incl. diagrs. tables, refs. (In cooperation with Louisiana State U., Baton Rouge, La.) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)678 and National Science Foundation) Unclassified

Published in Jour. Chem. Phys., v. 32: 357-361, Feb. 1960.

The emission spectrum of the anthracene-sym-trinitrobenzene complex has been investigated in a solid solution. The observed luminescence consists of two distinct electronic transitions: one, which is the reverse of the charge-transfer E ← N absorption of the complex and the other, which is a phosphorescence very similar to the T → S emission of anthracene in diethiether-isopentane, but blurred somewhat in vibrational structure and showing decreases in the ground state vibrational frequencies of a few per cent. These results suggest that the phosphorescence is truly a T → S process of the complex which is largely localized on the anthracene component. (Contractor's abstract)

650

Florida State U. [Dept. of Chemistry] Tallahassee.

PROTON TRANSFER STUDIES BY NUCLEAR MAGNETIC RESONANCE. II. RATE CONSTANTS AND MECHANISM FOR THE REACTION, $CH_3NH_3^+ + OH_2 + NH_2CH_3$, IN AQUEOUS ACID, by E. Grunwald, P. J. Karabatsos and others. [1960] [24]p. incl. diagrs. tables, refs. (AFOSR-TN-60-158) (AF 49(638)-278) AD 235155 Unclassified

Also published in Jour. Chem. Phys., v. 33: 556-563, Aug. 1960.

Rate constants were measured by precise nuclear magnetic resonance techniques for the reactions, $CH_3\underline{N}H_3^+ + NH_2CH_3 \xrightarrow{k_6} CH_3\underline{N}H_2 + H^+ NH_2CH_3$, and $CH_3\underline{N}H_3 + OH_2 + NH_2CH_3 \xrightarrow{k_7} CH_3\underline{N}H_2 + HOH + HNH_2CH_3$, in aqueous acid at 25°. The ratio, k_6/k_7, remained virtually constant between 1.7 and 8.1 M concentration of CH_3NH_3Cl. The rate constants were inversely proportional to the viscosity of the solution, and were extrapolated on this basis to infinite dilution to yield the values, $k_6^\circ = 4.0 \times 10^8$ sec^{-1} M^{-1} and $k_7^\circ = 5.3 \times 10^8$ sec^{-1} M^{-1} at 25°. Acid dissociation constants, densities and viscosities for 1.7 to 9 M solutions of CH_3NH_3Cl in water were measured also. Measurements of the water activity of these solutions showed that the mean ionic molal activity coefficients of CH_3NH_3Cl were virtually constant over the entire range. The magnitude of k_7, as well as the constancy of k_7/k_6, indicated that the most probable rate-determining step for the reaction with rate constant, k_7, is proton transfer from a water molecule in the solvation sheli of $CH_3NH_3^+$ to a molecule of CH_3NH_2, to produce the tripie ion, $CH_3\overset{+}{N}H_3 \cdot \overline{OH} \cdot HNH_2^+CH_3$. (Contractor's abstract)

651

Florida State U. [Dept. of Chemistry] Tallahassee.

PROTON TRANSFER STUDIES BY NUCLEAR MAGNETIC RESONANCE. I. DIFFUSION CONTROL IN

THE REACTION OF AMMONIUM ION IN AQUEOUS ACID, by M. T. Emerson, E. Grunwald, and R. A. Kromhout. [1960] 31p. incl. tables, refs. (AFOSR-TN-60-159) (AF 49(638)278) AD 235140
Unclassified

Also published in Jour. Chem. Phys., v 33: 547-555, Aug. 1960.

A study was begun on the dependence of the proton transfer rates of ammonium salts in acidic solutions on the acid and base strengths of the proton donor and acceptor. The rate constants were determined by nuclear magnetic resonance techniques for the reactions: $NH_4^+ + H_2O \underset{k_{-4}}{\overset{k_4}{\rightleftharpoons}} NH_3 + H_3O^+$; $NH_3 + H_3O^+ \underset{k_{-4}}{\overset{k_4}{\rightleftharpoons}} NH_4^+ + H_2O$; and $\underline{NH}_4^+ + NH_3 \underset{k_6}{\overset{k_6}{\rightleftharpoons}} \underline{NH}_3 + NH_4^+$ in aqueous acid at 25° C. The order of magnitude of k_{-4} and k_6 suggested that these reactions are diffusion-controlled. Calculation of the frequency of encounters by application of the Debye-Smoluchowski theory showed that k_{-4} is consistent with reactions occurring whenever H_3O^+ and NH_3 are next-nearest neighbors. The steric factor for this reaction appeared to be unity. It was concluded that the reactants were oriented during their approach so that the unshared electrons of the NH_3 faced an acidic H. To interpret k_6, a mechanism was assumed in which NH_3 and NH_4^+ became next-nearest neighbors by simple diffusion; the jump to a nearest-neighbor site then required a somewhat higher activation energy than simple diffusion because NH_3 had to displace a tightly-bonded H_2O molecule. The reaction with rate constant k_4 was activation-controlled. The negative salt effect on k_4 suggested diffusion of charge in the transition state. (ASTIA abstract)

652

Florida State U. [Dept. of Chemistry] Tallahassee.

PROTON TRANSFER STUDIES BY NUCLEAR MAGNETIC RESONANCE. III. THE MEAN LIFE OF THE AMINE-WATER HYDROGEN BOND IN AQUEOUS SOLUTION, by M. T. Emerson, E. Grunwald and others. [1960] [3]p. incl. diagrs. tables, refs. (AFOSR-J1379) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)2[illegible] and Alfred P. Sloan Foundation) AD 429773
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 6307-6314, Dec. 20, 1960.

Isotopic hydrogen exchange rates in very strongly acidic solutions provide a method for measuring the mean life of hydrogen bonds between water molecules (as donors) and amine molecules (as acceptors). Applied to NH_3, CH_3NH_2, and $(CH_3)_2N$, the results yield a criterion for the formation of genuine molecular complexes. Mean lives, extrapolated to dilute aqueous solution, were respectively, 2.0×10^{-12}, 1.2×10^{-11} and 1.0×10^{-10} sec. (Contractor's abstract)

653

Florida State U. Dept. of Chemistry, Tallahassee.

IONIZATION POTENTIALS OF BENZENE, HEXADEUTEROBENZENE, AND PYRIDINE FROM THEIR OBSERVED RYDBERG SERIES IN THE REGION 600-2000A, by M. F. A. El-Sayed, M. Kasha, and Y. Tanaka. [1960] [2]p. incl. table. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)712] and Harvard U., Cambridge, Mass.)
Unclassified

Published in Jour. Chem. Phys., v. 34: 334-335, Jan. 1961.

In the region 700-850A, Rydberg series are observed with 0,0 series converging at 10.84 ev, for benzene. This series is relatively diffuse with a simple, strong vibrational coupling. At 1050-1350A, several sharp and well-developed series are found, the strong bands of which fit the 2 main series converging to 11.48 ev for benzene and 11.52 ev for benzene-d. The Rydberg series in the 1300-1850A gives a value which is in good agreement with that of Wilkinson (9.247 ± 0.002 ev). For pyridine a well-developed Rydberg series is found converging to 9.26 ev, slightly higher than the lowest I. P. of benzene. This is a somewhat more diffuse series compared to the corresponding one of benzene. A group of a few strong lines in the range 1200-1266A were also observed for pyridine. This group can be arranged in a Rydberg series which converges at about 10.3 ev.

654

Florida State U. Dept. of Mathematics, Tallahassee.

CONCERNING A THEOREM OF KY FAN'S, by B. L. Sanders. [1960] [5]p. (AFOSR-3323) (AF 49(638)598)
Unclassified

Published in Math. Zeitschr., v. 76: 51-55, May 1961.

Let A_i $(1 \leq i \leq n)$ be n infinite sets and let f_i be a one-to-one mapping from A_i into A_{i+1} $(A_{n+1} = A_1)$. For even n, Ky Fan proved that each A_i can be decomposed into two disjoint subsets B_i, C_i such that $f_i(B_i) = C_{i+1}$ $(C_{n+1} = C_1)$ (Math. Zeitschr., v. 55: 308-309, 1952). A. Froda pointed out that this is not true for odd n. The following result is obtained for odd n: In order that each A_i can be decomposed into two disjoint subsets B_i, C_i such that $f_i(B_i) = C_{i+1}$ $(C_{n+1} = C_1)$, it is necessary and sufficient that the subset Q can be decomposed into two disjoint subsets Q', Q'' such that $g(Q') = Q''$.

655

Florida State U. [Dept. of Physics] Tallahassee.

ENERGY LEVELS OF He^5 AND Li^5, by L. D. Pearlstein, Y. C. Tang, and K. Wildermuth. [1960] [11]p. incl. diagrs. refs. (AFOSR-TN-60-1155) [AF 49(638)427] Unclassified

Published in Phys. Rev., v. 120: 224-234, Oct. 1, 1960.

The energies of the first three levels in He^5 are determined using a variational procedure. The various wave functions adopted incorporate alpha, triton, and deuteron correlations. It is determined that the ground state (3/2-) must be an alpha-neutron configuration whereas the (1/2-) level, which must also be described by this configuration, is not a sharp resonant state. The (3/2+) level at 16.69 mev is shown to be a deuteron-triton configuration. The resultant energies and structures of these levels are in accord with the experimental situation. It should be stressed that our wave functions differ appreciably from the standard shell-model ones in the intermediate-coupling picture. (Contractor's abstract)

656

Florida State U. Dept. of Physics, Tallahassee.

NUCLEAR BAND STRUCTURE IN Sc^{41}, by R. H. Davis. [1959] [2]p. incl. diagr. table. (AFOSR-TN-60-1156) (AF 49(638)427) Unclassified

Also published in Phys. Rev., v. 115: 1679-1680, Sept. 15, 1959.

Excitation energies and assignments of states in Sc^{41} observed by elastic scattering of protons are given. The excitation energies expected for a recurrence of these states above an excited Ca^{40} core are presented. Band structure predictions assuming the formation of proton single-particle states above the Ca^{40} core in the ground state or one of its excited states are compared with the available data on the elastic and inelastic scattering of protons from Ca^{40}. The band expected above the 3.35-mev state in Ca^{40} is confirmed by experimental results, and some evidence is found for bands above the higher core states.

657

Florida State U. [Dept. of Physics] Tallahassee.

LOW LYING LEVELS OF Li^7 AND Be^8 IN THE CLUSTER MODEL, by L. D. Pearlstein, Y. C. Tang, and K. Wildermuth. [1960] [30]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1157) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)427 and National Science Foundation) Unclassified

Also published in Nuclear Phys., v. 18: 23-39, Aug. 1960.

A study of the first few levels of Li^7 and Be^8 has been conducted. To calculate the appropriate energies, a variational procedure was adopted in which some of the long-range nuclear correlations were incorporated in the wavefunction wherein they appear as favored cluster configurations, i.e., alpha, triton groups. Agreement with experiment was obtained for the three rotational levels of Be^8 and the two rotational levels of Li^7. For the first change of parity level in the latter nucleus, however, arguments are presented indicating that the inclusion of a deuteron substructure would reproduce the properties of this level. (Contractor's abstract)

658

Florida State U. Dept. of Physics, Tallahassee.

GRAZING COLLISIONS OF COMPLEX NUCLEI, by R. H. Davis. [1960] [8]p. incl. diagrs. (AFOSR-TN-60-1158) (AF 49(638)427) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 244, Apr. 25, 1960.

Also published in Phys. Rev. Ltrs., v. 4: 521-522, May 15, 1960.

By assuming the interaction potential between 2 complex nuclei to be the sum of the Coulomb, momentum, and optical model potentials, a potential results which possesses a sharp minimum for the high orbital angular momenta characteristic of grazing collisions. The width of the well depends strongly on the orbital angular momentum and the diffuseness parameter. Approximating the well by that of a harmonic oscillator, states are found which corresponds to radial vibrations of the heavy ions about the center of mass of the system. The rotational contributions to the excitation energy of these states was calculated assuming moments of inertia equal to the reduced mass times the square of the separation of the complex nuclei. Using the diffuseness parameter given by Igo, $r_0 = 1.2f$, and V = 40 mev, the vibrational state separation for carbon-carbon and oxygen-oxygen scattering is about 8 and 6 mev (center of mass), respectively. The computed excitation energies of the states cluster at intervals about equal to those of the vibrational excitations for bombarding energies less than 40 mev. Because of the sensitivity of the level parameters to the shape of the potential, the observation of such states would provide detailed information about the optical model potential.

659

Florida State U. Dept. of Physics, Tallahassee.

SCATTERING OF HIGH-ENERGY NUCLEONS BY A

NONLOCAL POTENTIAL, by R. H. Lemmer, Y. C. Tang, and W. E. Frahn. [1960] [2]p. incl. diagr. [AF 49(638)427] Unclassified

Published in Phys. Rev., v. 118: 269-270, Apr. 1, 1960.

The scattering of high-energy nucleons by a simple nonlocal potential is examined in the Born approximation. It is shown that an energy dependent local potential is not fully equivalent to a nonlocal potential. The latter potential introduces an additional angular dependence in the differential cross section which seems to be particularly significant in the backward directions.

660

Florida State U. [Dept. of Physics] Tallahassee.

EVIDENCE FOR THE FIRST EXCITED STATE OF He^5 (Abstract), by B. O. Hannah, E. B. Carter, and R. H. Davis. [1960] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 229, Apr. 25, 1960.

The $Li^7(d,\alpha)He^5$ reaction leading to the ground state and the first excited state of He^5 were studied by bombarding natural lithium targets with 120 kev deuterons. To separate the alpha-particle group populating the first excited state from the broad 3-bodied breakup continuum due to the $Li^7(d,\alpha)He^4 + He^4$ reaction, the alpha-particle yield was measured at 90° to the beam in coincidence with a neutron counter. Bias on the neutron counter was set above the ground state neutron group, i.e. [$Li^7(d,\alpha)He^5$, $He^5 \rightarrow He^4 + n$]. A peak was observed in the coincidence spectrum corresponding to an alpha-particle group populating a first excited state in He^5 at about 4.6 mev with a width of about 3 mev. A run on a blank aluminum target did not reveal this peak in the coincidence spectrum, and no other reaction is energetically possible at this bombardment energy except $Li^7(d,\alpha)He^5$ and $Li^7(d,n)He^4 + He^4$. The estimated upper limit for the ratio of the population of the first excited state to that for the ground state is 1:10.

661

Florida State U. [Dept. of Physics] Tallahassee.

COMPARISON OF CLUSTER-MODEL PREDICTIONS WITH EXPERIMENTAL NUCLEAR LEVELS (Abstract), by R. K. Sheline and K. Wildermuth. [1960] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 271, Apr. 25, 1960.

Nuclei may be considered to be composed of clusters (He^4, He^3, H^3, H^2, and free nucleons) similar in many respects to molecules in molecular physics. This cluster model predicts low-lying energy levels of parity different than the ground state (i.e., levels in higher shells) for nuclei in which there is a free neutron or proton incapable of further completing other clusters in this nucleus. The corresponding levels in nuclei containing di-neutrons, di-protons of deuterons as smallest clusters should be slightly higher. The greater stability of H^3, He^3, and He^4 cluster nuclei suggests still higher corresponding levels. This model further predicts that immediately after double closed-shell structures, nuclei with H^3 or He^3 clusters (e.g., F^{19}) will exhibit a strong decrease in this excitation energy. The negative parity states and first O^+ states in alpha-particle nuclei should decrease with increasing atomic number. These predicted systematics agree with the experimental data which are available but suggest the need for considerable additional data to further test the predictions. These results indicate substructures which are often more important than shell-model structures.

662

Florida State U. [Dept. of Physics] Tallahassee.

REDUCED α-PARTICLE WIDTHS, GAMMA-TRANSITION PROBABILITIES, IN THE LIGHT OF THE CLUSTER MODEL (Abstract), by B. Roth and K. Wildermuth. [1960] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 271, Apr. 25, 1960.

On the basis of the cluster model one expects large reduced α-particle widths for those excited states of a nucleus which can be described as an α-particle cluster bound to an unexcited cluster, and where no α-particle cluster is broken up. When the α-particle cluster is broken up or when the α particle is bound to an excited cluster, there should be a small reduced width for that state. One also expects the relative magnitude (in Weisskopf units) of the gamma-transition matrix element to be large when the states involved have a similar cluster structure, and to be small when they are dissimilar in cluster structure. From this point of view, the gamma radiation of the low-lying states of F^{19} and O^{16}, and the reduced α-particle widths of O^{16} were analyzed. Good agreement with experiment was found in all cases where data are available.

663

Florida State U. [Dept. of Physics] Tallahassee.

LOW-LYING LEVELS OF LIGHT NUCLEI IN THE CLUSTER MODEL (Abstract), by L. D. Pearlstein, Y. C. Tang, and K. Wildermuth. [1960] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 271-272, Apr. 25, 1960.

The low-lying energy levels of light nuclei with A = 6, 7, 8 are computed by the Ritz variational method. The trial wave functions are chosen to exhibit the feature of relatively long-range correlations as clustering of nucleons in those various nuclei. For instance, in the case of Li^7, the wave function is written as the antisymmetrized product of a part which represents the internal structures of an α-particle cluster and a triton cluster and a part which describes the relative motion between the two clusters. To facilitate computations, it is assumed that the interaction energy between the clusters is little influenced by the hard-core part of the nuclear two-body force; hence, it can be approximately calculated by a Serber force of nonsaturating character. For the internal energies of the clusters, values computed by Mang and Wild using saturated force with hard core are adopted. Numerical results indicate that our computations yield good agreement with both the ground-state energies and the energies of the first excited states of those nuclei considered.

664

Florida State U. [Dept. of Physics] Tallahassee.

ASYMMETRIC AND SYMMETRIC FISSION AND THE CLUSTER MODEL (Abstract), by K. Wildermuth. [1960] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 272, Apr. 25, 1960.

It is suggested that asymmetric fission involves 2 essentially unexcited clusters with N = 50 and N = 82, respectively. These energetically favored nuclear cluster structures can exist in a nucleus without destroying the 126 shell of neutrons because of the indistinguishability of the nucleons. In symmetric fission, however, these substructures have disappeared. It will be shown that all experimental facts of fission agree with this concept. In particular, (1) the triple peaked mass distributions observed present evidence that the familiar change from asymmetric to symmetric fission with increasing excitation energy means the appearance of a new distinct fission mode, rather than simply filling up the valley; (2) the excitation energies of fragments measured so far show a minimum at the most probable (asymmetric) mass division, rather than a maximum; (3) the very existence of the angular anisotropies observed implies that only a few fission channels are open, contrary to any statistical description.

665

Florida State U. [Dept. of Physics] Tallahassee.

DI-NUCLEUS MODEL FOR SCATTERING OF COMPLEX NUCLEI, by R. H. Davis. [1960] [4]p. incl. diagrs. [AF 49(638)427] Unclassified

Published in Proc. of the Second Conf. on Reactions Between Complex Nuclei. Gatlinburg, Tenn. (May 2-4, 1960), New York, Wiley and Sons, 1960, p. 297-300.

According to the Blair model the impact parameter for elastic scattering of complex nuclei exceeds some characteristic value which may be associated with a grazing collision. Once contact is made between the two surfaces there are two repulsive forces, the Coulomb force and the centrifugal force, which are opposed by a specifically nuclear attractive force. The potential V for an incoming particle is the superposition of three terms: The specifically nuclear interaction V_n, the centrifugal potential V_m, and the Coulomb potential V_c. V_n is taken to be: $V = V_n + V_m + V_c$, where $V_n = -V_o \left[1 + \exp\left(\frac{R-R_o}{d}\right)\right]^{-1}$ $V_o = 40$ mev, d = 0.574 fermi, $R_o = 1.2 (A^{1/3} + A^{1/3})$ fermis, $V_m = \frac{\hbar^2}{2} L(L+1)$, $\mathcal{I} = M_r R^2$, $V_c = \frac{Z_1 Z_2 e^2}{R}$. Centrifugal and Coulomb terms have their usual forms. Applying this to the carbon-carbon scattering various orbital angular momenta -L are 6, 8, 10, 12, 14. Similar results are shown for the oxygen-oxygen system.

666

Florida State U. [Dept. of Physics] Tallahassee.

COULOMB EXCITATION OF BETA- AND GAMMA-VIBRATIONAL STATES IN Sm^{152}, by R. K. Sheline, H. L. Nielsen, and A. Sperduto. [1960] [11p. incl. diagrs. tables, refs. (In cooperation with Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge) (AF 49(638)427) Unclassified

Published in Nuclear Phys., v. 16: 518-528, May 1960.

A Sm^{152}-target made by electromagnetic isotope separation has been bombarded with 7.5-8.5 mev deuterons and 8.6 mev protons. Inelastic scatter groups corresponding to Coulomb excitation of the level at 122 kev have been observed in every case, and in 1 run with 8.5 mev deuterons Coulomb excitation of levels at 807 kev and 1079 kev has been seen. The reduced transition probabilities to these states are measured as 4.1 ± 0.1, 0.007 ± 0.02 and 0.12 ± 0.02, respectively, in units of $e^2 \times 10^{-48}$ cm^4. The reduced transition probabilities for the 2 highest excited states are several times the

single particle values. This is a strong indication of the collective nature of both these states. Accordingly, these levels are interpreted as beta- and gamma-vibrational states. The partial lifetime and the nuclear strength parameter for the EO-transition between the 807 kev and the 122 kev levels have been calculated from the experimental data and are found to be in poor agreement with the theoretical values. (Contractor's abstract)

667

Florida State U. [Dept. of Physics] Tallahassee.

$C^{12}(p,p'\gamma_{4.43})C^{12}$ EXCITATION FUNCTIONS BETWEEN 5 AND 11 MEV (Abstract), by H. S. Adams, J. A. Becker and others. [1960] [1]p. [AF 49(638)-427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago U., Ill., Nov. 25-26, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 404, Nov. 25, 1960.

The excitation function for $C^{12}(p,p'\gamma)C^{12}$ has been extended to 11.5 mev bombarding energy. The 4.43-mev gamma ray was detected from the first excited state of C^{12} produced in a thin (0.3 mg/cm^2) carbon foil at 90° with a 5-in. x 4-in. NaI(Tl) crystal. In addition to the known resonances at 5.36 and 5.89 mev, a number of resonances corresponding to states in N^{13} of up to 12-mev excitation were seen. Also observed was a smoothly rising yield underlying the resonances, beginning at about 6 mev. The approximate energies of the observed resonances are listed. Measurements of angular distribution of the 4.43-mev gamma rays are in progress at several energies.

668

Florida State U. [Dept. of Physics] Tallahassee.

SCATTERING OF PROTONS BY CARBON (Abstract), by F. L. Bordell, G. E. Mitchell and others. [1960] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago U., Ill., Nov. 25-26, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 404, Nov. 25, 1960.

States in N^{13} have been studied by scattering protons from thin carbon foils (99% C^{12}, 0.2 mg/cm^2). In the proton bombarding energy range 5.2 to 11.3 mev, elastic scattering anomalies have been observed at 5.37, 5.90, 6.6, 7.50, 8.2, 9.15, 10.31, 10.55, and 11.00 mev. The 6.6-mev anomaly is several mev wide and is consistent with a $3/2^+$ assignment for the state in N^{13}. Resonances at 5.37, 5.90, and 6.6 have been reported in the literature, and the anomalies at 7.5, 8.2, 9.15, 10.31, and 10.55 have been observed by Dearnaley and Whitehead. Except for the 6.6-mev resonance, the resonances have appreciable inelastic widths. Although complicating the elastic scattering analysis, the observation of the angular distribution of the inelastic proton group assists in removing ambiguities in level assignments. The excitation curve from 10.1 to 11.3 indicates the existence of at least 3 resonances in that interval. Phase shift analysis is being carried out with the assistance of an IBM 650 computer.

669

Florida State U. [Dept. of Physics] Tallahassee.

PARAMETERS FOR A DINUCLEUS MODEL FOR HEAVY ION REACTIONS (Abstract), by R. H. Davis. [1960] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago U., Ill., Nov. 25-26, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 405, Nov. 25, 1960.

A dinucleus model has been proposed in which the specifically nuclear part of the potential is the real optical model potential. Analysis of recent Chalk River experiments on the $C^{12} + C^{12}$ system yield assignments of 8^+ and 4^+ for the resonances at 5.65 and 5.98 mev (cm), respectively. While the parameters adopted from Porter's work predict at 4^+(N = 3, L = 4) level near 6 mev, no 8^+ level lay within 3 mev. By determining the variation of energy levels with the depth, diffuseness, and radius parameters, the effects of parameter adjustments and the uniqueness of values can be studied. The C + C data can be fitted with a well depth of 48.5 mev and diffuseness of 0.80 f, the latter being weakly determined. By leaving V_0 = 40 mev and δ = 0.574 f, pairs of L = 4 and 8 resonances are also fitted for 2 values of the radius parameter (1.32 and 1.50 f). Experimental assignments for additional levels in the C + C or other systems are needed to remove the ambiguity. Theoretical results will be presented for the C + O, O + O, and N + N systems for several sets of parameters. By adding an imaginary part to the potential well, the reaction cross sections may be parameterized. The formation of dinucleus states is intimately related to the extension of the real potential outside the absorptive region.

670

Florida State U. [Dept. of Physics] Tallahassee.

(p,n) THRESHOLDS IN Ti^{48}, Fe^{56}, AND Si^{88} (Abstract), by J. W. Nelson, H. S. Adams and others. [1960] [1]p. [AF 49(638)427] Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago U., Ill., Nov. 25-26, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 424, Nov. 25, 1960.

By using the slow-fast counter ratio technique, the

neutron thresholds have been determined with the Tandem Van de Graaff accelerator. The analyzing magnet was calibrated using the known $C^{13}(p, n)N^{13}$ (3237.2-kev) threshold. The new thresholds will be compared with Q values calculated from beta decay data as well as known excited states in the odd-odd residual nuclei.

671

Florida U. Engineering and Industrial Experiment Station, Gainesville.

EFFECT OF MEMBRANE FORCES ON LATERAL VIBRATIONS OF RECTANGULAR PLATES, by M. Trubert and W. A. Nash. May 1960 [53]p. incl. diagrs. tables, refs. (Technical note no. 2) (AFOSR-TN-60-437) (AF 49(638)328) AD 239042; PB 148786 Unclassified

Published in Developments in Mechanics, Proc. of the Seventh Midwestern Mechanics Conf., Michigan State U. (Sept. 6-8, 1961), New York, Plenum Press, 1961, v. 1: 39-46.

A solution to the problem of finding the natural modes of vibration of a rectangular plate loaded by membrane forces, i.e. tension (or compression), in the middle plane, is sought by the perturbation technique. The eigenvalues and eigenfunctions for the plate subjected to tension are deduced from the known eigenvalues and eigenfunctions for the plate with no tension, for the usual boundary conditions, by the use of series involving powers of the tension. General expressions for the series are formulated using the eigenfunctions of the plate with no tension as normal functions. An exact solution of the problem is given for the case of simply supported edges. A comparison is made between this last solution and the approximate solution using the perturbation technique for the same boundary conditions. A second application is made to a clamped square plate. The necessary known modes to start with are those obtained by D. Young, who used the Rayleigh-Ritz procedure assuming the beam shapes as normal functions in both directions of the plate. For the fundamental mode the result is compared with that obtained by A. Weinstein and W. Z. Chien.

672

Fordham U. Dept. of Chemistry, New York.

SYDNONES. III. PREPARATION AND INTERCONVERSION OF MERCURATED DERIVATIVES OF N-(3-PYRIDYL)SYDNONE, by J. M. Tien and I. M. Hunsberger. May 31, 1960, 18p. incl. diagrs. tables, refs. (AFOSR-TN-60-583) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)-127 and National Cancer Institute under CY-2962) AD 239167; PB 148877 Unclassified

Presented at the Meeting-in-Miniature of the New York Amer. Chem. Soc. Section, Mar. 11, 1960. Presented at 138th meeting of the Amer. Chem. Soc., New York, Sept. 1960.

Also published in Jour. Amer. Chem. Soc., v. 83: 178-182, Jan. 5, 1961.

Mercuration of N-(3-pyridyl)sydnone (II) has produced either the sydnone-mercuric chloride "adduct" (V), C-chloromercuri-N-(3-pyridyl)sydnone (VI), or C,C'-mercuri-bis-[N-(3-pyridyl)sydnone] (VII), depending on the reaction conditions. The adduct (V) has been converted to VI and to VII. Transformations of VI to VII was accomplished in pyridine solution at room temperature, while VII was converted to VI with excess mercuric chloride. All reactions proceeded in high yield. Sydnones undergo electrophilic substitution virtually as easily as thiophene. Objections to the tropone-like formulation (XI) of sydnones are presented. Preparation of N-(3-pyridyl)glycine hydrochloride via a Strecker-type reaction between 3-aminopyridine and glycolonitrile is more convenient than the earlier process and permits the preparation of large quantities of sydnone II. (Contractor's abstract)

673

Fordham U. Dept. of Chemistry, New York.

PREPARATION OF N-SUBSTITUTED GLYCINES. II. N-(3,5-DINITRO-2-THIENYL)GLYCINE, by J. M. Tien and I. M. Hunsberger. [1960] 4p. (AFOSR-TN-60-584) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)127 and National Cancer Institute) Unclassified

Also published in Jour. Org. Chem., v. 25: 2056-2057, Nov. 1960.

N-(3,5-dinitro-2-thienyl)glycine was prepared by acid hydrolysis of its ethyl ester. Apparently, two nitro groups on the thiophene ring exert effects comparable to three nitro groups on the benzene ring. In this connection, it is noteworthy that N-(3,5-dinitro-2-thienyl)glycine separated as the free base from aqueous hydrochloric acid and that the ester did not form a hydrochloride salt in absolute C_2H_5OH saturated with dry hydrogen chloride.

674

Fordham U. Dept. of Chemistry, New York.

FACILE BROMINATION OF PYRIDINE-TYPE HETEROCYCLES AT THE β-POSITION, by E. E. Garcia, C. V. Greco, and I. M. Hunsberger. [1960] [2]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)127 and Public Health Service) Unclassified

Published in Jour. Amer. Chem. Soc., v. 82: 4430-4431, Aug. 20, 1960.

An exception to the usual difficulty involved in substitution in the pyridine ring is the ease of bromination in the presence of SO_2Cl_2 or S_2Cl_2. Thus, this

reaction is likely not an electrophilic substitution in the pyridine-type ring itself, but rather in

CH:CH·NR·CH:CH·CHCl or CH:CH·NR·CH·CHN$^{+}C_5H_5$ Cl^{-} (R = SO_2Cl or S_2Cl). Electrophilic bromination of either (having a vinylamine structure) would proceed readily. Otherwise, substitution in the ring already having an electron-withdrawing substituent (formation of a dibromo-derivative, which is described) would not be expected. This mechanism is like the ones described to explain bromination and nitration of stable compounds of structures like that proposed as formed, by reaction with SO_2Cl_2 or S_2Cl_2.

675

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

E2 TRANSITIONS FROM THE SECOND 2+ LEVEL OF EVEN-EVEN NUCLEI, by D. M. Van Patter. [1959] [28]p. incl. diagrs. tables, refs. (AFOSR-TN-60-414) (AF 49(638)512) AD 235215 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 30-May 2, 1959.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 4: 233, Apr. 30, 1959.

Also published in Nuclear Phys., v. 14: 42-69, Dec. 1959.

A survey was made of available data for the γ-ray branching of the second 2+ level of over 50 even nuclei with A > 30, together with data for the E2-M1 mixing of the (2' → 2) cascade transition. In addition, presently available data for the Coulomb excitation cross sections for the second 2+ level of some 24 even nuclei were collected. From these data, 3 ratios of reduced E2 transition probabilities were calculated, and compared with the predictions of various theories. The comparisons indicate that by far the most successful theory to date for predicting such ratios is the recent asymmetric rotor model of Davydov and Filippov (Nuclear Phys., v. 10: 654, 1959). Perhaps the most striking success of this theory is the prediction for the ratio B(E2; 2' → 0)/B(E2; 2 → 0) as a function of the energy ratio $E_2(2+)/E_1(2+)$. However, there are some experimental results which remain unexplained, particularly for the ratio B(E2; 2')/B(E2; 2' → 0). (Contractor's abstract)

676

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

BRANCHING RATIO OF THE SECOND 2+ LEVEL OF Zn^{64} AND Zn^{66} (Abstract), by R. Rikmenspoel and D. M. Van Patter. [1960] [1]p. [AF 49(638)512] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 66, Jan. 27, 1960.

Isotopically enrich thin targets on Formvar backings of Zn^{64} and Zn^{66} were bombarded with protons with Ep ≤ 5 mev. The beam stopper and defining slits were at about 8 in. from the target for reducing background due to bremsstrahlung and impurities on slits and beam stopper. Gamma rays from the decay of the first and second 2+ levels of both isotopes were observed at angles relative to the incoming beam varying from 30° to 150°. For the branching ratio (crossover/cascade) for the 1.80 mev, 2+ level in Zn^{64} a preliminary value of 0.41 was found. This value is in essential agreement with the value of 0.34 measured by Jacobi from radioactive decay. A preliminary value of 0.06 for the upper limit for the branching ratio of the 1.87 mev, 2+ level of Zn^{66} was found. These values indicate a difference for B(E2;2' → 2)/BE2;2' → 0) between these 2 nuclei of at least a factor of 7 (assuming all transitions to be pure E2 character), for which there seems no theoretical explanation.

677

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

DECAY OF Br^{78} (Abstract), by R. Rikmenspoel and D. M. Van Patter. [1960] [1]p. [AF 49(638)512] Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal, Canada, June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 338, June 15, 1960.

The decay scheme of $Br^{78}(\beta^{+})Se^{78}$ has not yet been established with certainty. Br^{78} sources were produced by proton bombardment of isotopically enriched (97% thin targets of Se^{78}. The (p,n) threshold for the Se^{78} (p,n)Br^{78} reaction was measured at 4.35 ± 0.01 mev with a slow-fast neutron counter arrangement. The proton energy was calibrated with the F^{19}(p,n) threshold at 4.24 mev. Annihilation radiation with a half-life of 6.4 ± 0.2 min was observed for bombardments with E_p > 4.35 mev. After bombardment with 4.35 mev ≤ E_p < 4.48, the β^{+} decay showed no evidence of the growth of a daughter state from an isomeric level. By using an anthracene crystal, the end point of the β^{+} spectrum of Br^{78} was measured at 2.52 mev in essential agreement with Q of the (p,n) reaction of -4.30 mev. The energy was calibrated by means of the β^{+} spectra of Ga^{68}, Zn^{63}, and Cu^{62}. A gamma ray of 0.615 mev was observed in the decay of Br^{78}, which is assigned to the first 2+ level of Se^{78} on the basis of its half-life of approximately 6.5 min.

678

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

APPARATUS FOR ZONE REFINING HIGHLY REACTIVE METALS, by G. F. Spangler, M. Herman, and J. L. Rutherford. Interim rept. July 1960, 10p. incl. diagrs. (Rept. no. I-A1878-5) (AFOSR-TN-60-693) (AF 18(600)1581) AD 240712; PB 161929 Unclassified

A technique which utilizes a static inert atmosphere in a hermetically sealed all-gas system has been developed for the successful floating zone refining of highly reactive metals. The atmosphere is gettered internally on a discardable section of the bar. The apparatus includes a water cooling jacket around the protection tube to minimize silicon contamination and an improved magnetic vertical adjustment device which permits external control without an additional seal.

679

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

PROPERTIES OF ZONE REFINED TITANIUM AND ZIRCONIUM. PART I, by J. L. Rutherford, R. L. Smith, and M. Herman. Interim rept. July 1960, 30p. incl. illus. diagrs. (Rept. no. I-A1878-6) (AFOSR-TN-60-694) (AF 18(600)1581) AD 240822; PB 149955 Unclassified

Property measurements were made on zone-refined iodide titanium and iodide zirconium. The tensile properties of the zone-refined titanium were improved which was indicative of actual purification; there was a marked difference in properties along the length of the zone-refined bar, indicative of impurity redistribution. There was a correlation between the density of serrations in the tensile curves at 4.2 K and the impurity concentration of the zone-refined titanium. The fact that the tensile specimens tested in a "soft" machine at 4.2 K did not go to failure with the first catastrophic increment of strain is more likely explained by a twinning mechanism than by an unstable plastic flow mechanism. The zone-refined zirconium showed effects of impurity redistribution but the overall properties were, in general, poorer than those reported in the literature for high-grade iodide materials. These inferior properties were attributed to poor starting stock and to a fast rate of travel in the zone-refining operation. (Contractor's abstract)

680

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

PROPERTIES OF ZONE REFINED TITANIUM. PART II, by G. [F.] Spangler and M. Herman. Interim rept. July 1960, 36p. incl. illus. diagrs. tables, refs. (Rept. no. I-A1878-7) (AFOSR-TN-60-695) (AF 18-(600)1581) AD 241372; PB 150126 Unclassified

The recrystallization characteristics, grain growth kinetics, residual resistivity ratio and mechanical deformation characteristics of zone refined titanium are presented and discussed. Both the ultimate purification and the redistribution of impurities in the zone refined material have been evaluated in terms of these operational parameters. Observations are presented and discussed on the effect of purity and grain size on the tendency for discontinuous plastic flow at 4.2°K.

681

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

A CINEPHOTOMICROGRAPHIC STUDY OF THE ETCHING OF ZINC, by S. Tint and V. V. Damiano. Interim rept. July 1960, 10p. incl. illus. (Rept. no. I-A1878-8) (AFOSR-TN-60-696) (AF 18(600)1581) AD 240689; PB 149956 Unclassified

Also published in Rev. Scient. Instr., v. 32: 325-327, Mar. 1961. (Title varies)

A device consisting of a transparent cell to hold the sample and etchant, a microscope with vertical illuminator, and an electrically driven camera was constructed to obtain cinephotomicrographs of the action of a chromic acid etch on monocrystals and polycrystals of pure and Cd-doped Zn. Several sequences of these pictures are reproduced, showing looplike patterns similar in appearance to the Frank-Read dislocation source.

682

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

DISLOCATIONS AND IMPURITY BOUNDARIES IN ZINC CRYSTALS GROWN FROM THE MELT, by V. V. Damiano and S. Tint. Interim rept. July 1960, 13p. incl. illus. diagrs. refs. (Rept. no. I-A1878-9) (AFOSR-TN-60-697) (AF 18(600)1581) AD 241360 Unclassified

Also published in Acta Metall., v. 9: 177-183, Mar. 1961.

Using etch pit techniques, the arrangement of dislocations in cadmium doped high purity zinc crystals grown from the melt was investigated. Crystals which exhibit a cellular segregation structure at a decanted interface were progressively polished and etched to a depth of several millimeters behind the interface. The location of the etch pits at microsegregation and their rearrangement into networks is in agreement with Tiller's hypothesis [Jour. Appl. Phys., v. 29: 4, 1958] that dislocations are introduced during solidification to accommodate the lattice strain induced by the inhomogeneous distribution of impurities. Networks form when the dislocations are set free after homogenization occurs behind the solid-liquid interface. The dislocations then become arranged in walls perpendicular to the slip plane by climbing away from the impurity boundaries. This secondary substructure fully

developed 3 mm behind the solid-liquid interface increases in size as the crystal continues to grow and the dislocations climb and glide. (Contractor's abstract)

683

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

PURIFICATION AND SUBSTRUCTURE FORMATION OF METALS AND PROPERTIES OF HIGH PURITY METALS, by M. Herman. Final rept. Oct. 1, 1955-Mar. 31, 1960, 6p. (Rept. no. F-A1878) (AFOSR-TR-60-81) (AF 18(600)1581) AD 243579 Unclassified

The research dealt with studies of (a) the purification of high melting point reactive metals and an evaluation of some of their physical and mechanical properties, and (b) the substructure developed in metal crystals grown from the melt. The purification studies grew out of a desire to apply the floating zone method of zone refining to a group of metals which, because of their chemical reactivity, had not been produced to any exceptionally high degree of purity. A technique for zone purifying reactive metals by the method of the floating zone was developed where contamination by both crucible material and gaseous elements was eliminated or reduced to a minimum. These studies which represent the first application to metals of zone refining by the method of the floating zone have demonstrated that extremely reactive metals can be purified to an extent heretofore not possible. Of significance are the property changes observed in these metals as the levels of impurities were decreased. For example, in the case of "pure" iron the brittle-ductile transition in tension was found to be non-existent down to 4°K; in the case of "pure" titanium the kinetics of grain growth was observed to be determined by the energetics associated with grain boundary rather than volume diffusion. The research on substructure was directed toward a further understanding of the development of the imperfection and impurity structures developed in metals grown from the melt. The detailed formation of dislocation networks out of impurity boundaries was shown. The variation in the shape of impurity boundaries as a function of crystal geometry was determined. Of particular interest was the motion pictures revealing the formation of etch patterns on zinc.

684

Franklin Inst. [Labs. for Research and Development] Philadelphia, Pa.

PRECIPITATION IN GOLD-NICKEL SINGLE CRYSTALS, by P. J. Flanders and F. R. L. Schoening. [1960] [2]p. incl. diagr. (AFOSR-4433) (AF 49(638)-159) Unclassified

Also published in Jour. Appl. Phys., Suppl., v. 32: 344S-345S, Mar. 1961.

Magnetic, x-ray, and microscope examinations have been made on single-crystal disks of a Au-Ni alloy containing 24.8 at. % nickel to investigate the precipitation process. The precipitation begins on the surface at discrete areas which grow broader and deeper as annealing progresses. Magnetic data can be interpreted by assuming that the Ni-rich precipitate is elongated in the <111> directions, electron micrographs indicating the presence of elongation. The Ni-rich phase acquires a small degree of crystalline orientation with increased annealing, whereas the Au-rich phase maintains an appreciable amount of orientation throughout. (Contractor's abstract)

685

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

DISLOCATIONS IN DEFORMED SINGLE CRYSTALS OF α-BRASS. PART II. PILE-UPS, by J. D. Meakin and H. G. F. Wilsdorf. Interim rept. Feb. 1960, 26p. incl. illus. diagrs. tables, refs. (Rept. no. I-A2027-2) (AFOSR-TN-60-4) (AF 49(638)162) AD 233671; PB 147282 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 128: 745-752, Aug. 1960.

An etching technique was used to investigate the dislocation structure of deformed alpha -brass single crystals. Isolated single ended pile-ups were observed, and it is shown that, in certain cases, the configurations of such pile-ups agree with theoretical predictions. Many discrete pile-ups within heavily deformed regions were also detected and the influence of surrounding dislocations on these groups are reported and discussed. Divergences between the experimental and theoretical spacings in the isolated pile-ups and the origin of the stress maintaining the pile-ups are discussed. (Contractor's abstract)

686

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

PREPARATION OF THIN METAL FOILS FROM ORDINARY TENSILE SPECIMENS FOR USE IN THE TRANSMISSION ELECTRON MICROSCOPY, by P. R. Strutt. [1960] [3]p. incl. diagrs. (AFOSR-4407) (AF 49(638)-162) AD 295962 Unclassified

Presented at annual meeting of the Electron Microscope Soc. of Amer., Marquette U., Milwaukee, Wis., Aug. 29-31, 1960.

Abstract published in Jour. Appl. Phys., v. 31: 1834, Oct. 1960.

Also published in Rev. Scient. Instr., v. 32: 411-413, Apr. 1961.

Methods of preparing thin films from ordinary tensile specimens have been devised to observe dislocation configurations produced by straining the bulk specimens. All the procedures are electrolytic so as to avoid introducing mechanical strains. Initially, sections are cut from the bulk specimen; if desired, the

section may be cut parallel to a desired crystallographic plane. The section is then electrolytically planed down to a uniform thin sheet. The final stage is the preparation of the electron transparent area from the planed down thin sheet. (Contractor's abstract)

687

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

REFINEMENTS OF THE THEORY OF THE INFINITELY-LONG, SELF-ACTING, GAS-LUBRICATED JOURNAL BEARING, by H. G. Elrod, Jr. and A. Burgdorfer. Interim rept. Jan. 1960, 43p. incl. diagrs. tables. (Rept. no. I-A2049-10) ([Sponsored jointly by Air Force Office of Scientific Research] and Office of Naval Research under Nonr-234200) Unclassified

Also published in Proc. First Internat'l. Symposium on Gas Lubricated Bearings, Washington, D. C. (Oct. 26-28, 1959), Washington, Office of Naval Research, 1959, p. 93-118.

The lubrication equations for an arbitrary Newtonian fluid are derived directly from the general equations for conservation of mass, momentum, and energy. From the lubrication equations an inequality is obtained for the internal film temperature rise. The isothermal film equations are then derived. Then for perfectly-aligned self-acting journal bearings, a conservation equation is obtained. For gas bearings this condition gives: $\int_0^{2\pi} P^2 h^3 d\Theta$ = constant along the axis of the bearing. Application of this condition to the infinitely-long gas bearing gives more accurate pressure solutions for this case. The Katto-Soda form of the differential equation for the infinitely-long bearing is solved by a series expansion in the eccentricity ratio, the first terms of which give the original approx Katto-Soda solution. In addition, solutions obtained numerically by digital computations are presented in graphical and tabular form for eccentricity ratios from $0 \rightarrow 0.9$ and compressible bearing parameter, λ_1 from $0 \rightarrow \infty$. Design charts based on these calculations are provided. (Contractor's abstract)

688

Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.

PERTURBATION ANALYSIS OF THE STABILITY OF SELF-ACTING GAS-LUBRICATED, JOURNAL BEARINGS, by V. Castelli and H. G. Elrod, Jr. Interim rept. Feb. 1960, 25p. incl. diagr. refs. (Rept. no. I-A2049-11) ([Sponsored jointly by Air Force Office of Scientific Research] and Office of Naval Research under Nonr-234200) AD 234380 Unclassified

The dynamics of a gas-lubricated journal bearings are studied by using Reynold's equation and the Lagrangian equations of motion. This system of equations is then linearized by the perturbation method. The stability of the bearing is investigated by studying the location in the complex plane of the roots of the characteristic determinant of the solution of the system of governing equations. (Contractor's abstract)

689

Free U. of Brussels (Belgium).

IRREVERSIBLE PROCESSES IN GASES. III. INHOMOGENEOUS SYSTEMS, by I. Prigogine and R. Balescu. [1960] [15]p. incl. diagrs. refs. [AF 61-(514)957] Unclassified

Published in Physica, v. 26: 145-159, Mar. 1960.

The technique of finding an asymptotic solution of Liouvilles' equation by formal iteration and classifying the terms by means of diagrams is generalized further. It is claimed that the results reveal a characteristic difference between the approach to equilibrium of homogeneous and inhomogeneous systems.

690

Free U. of Brussels (Belgium).

INFLUENCE OF EROSIVE BURNING ON INTERNAL BALLISTICS, by J. A. Vandenkerckhove. Oct. 1960, 49p. incl. diagrs. tables, refs. (Technical note no. 1) (AFOSR-TN-60-1403) (AF 61(052)354) Unclassified

Empirical laws do not describe accurately the influence of erosive burning (on solid propellant rocket motors), and the factors influencing the burning rate without erosion apparently do not retain their influence in the presence of a high velocity flow. It is preferable to base internal ballistics computation on actual experimental data and a method is proposed for calculating the front pressure as a function of combustion to throat, and throat to port area ratios. The method is rigorous for a constant port area and it is also shown that a small port area taper along the grain length does not introduce a significant error. The problems of constant mass velocity and constant burning rate designs are briefly discussed. (Contractor's abstract)

691

Free U. of Brussels (Belgium).

THE ROLE OF RIBONUCLEIC ACID AND SULFHYDRIL GROUPS IN MORPHOGENESIS, by J. Brachet. [1960] [35]p. incl. illus. refs. (AFOSR-2511) (AF 61-(052)356) Unclassified

Also published in Growth in Living Systems, Proc. of an Internat'l. Symposium on Growth, Purdue U. (June 16-18, 1960), New York, Basic Books, Inc., 1961, p. 241-275.

A review is presented of the function of RNA and the

-SH groups in relation to morphogenesis). The results presented here seem to indicate that fundamentally morphogenesis is a problem of specific protein synthesis.

692

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

ON THE FIELD-MATTER INTERACTION IN CLASSICAL ELECTRODYNAMICS, 1, by I. Prigogine and B. Leaf. [1959] [13]p. (AFOSR-TN-60-738) (AF 61(052)179] Unclassified

Published in Physica, v. 25: 1067-1079, Nov. 1959.

The problem of the interaction between a classical charged particle and its self-field is treated by a perturbation method based on the Liouville equation. With this formalism one can represent the behavior of the system (field + matter) with a single linear partial differential equation. To the order e^2, the only modification introduced by the self-field, in the absence of external forces, is a renormalization of the mass. The method is thus similar to those of current field theories, but it is claimed that it may present advantages in certain applications, particularly for the study of non-Hamiltonian problems. As an example, it is applied to the motion of a charged particle in a black body, where the mass depends on the temperature, thus allowing in principle a separation between electromagnetic and non-electromagnetic mass.

693

Free U. of Brussels. [Dept. of Chemical Physcs] (Belgium).

IRREVERSIBLE PROCESSES IN A QUANTUM PLASMA, by R. Balescu. [1960] [2]p. (AFOSR-TN-60-1192) [AF 61(052)179] AD 244355 Unclassified

Published in Physica, v. 26: 443-444, June 1960.

In an earlier paper (see item no. 695, Vol. IV), a transport equation has been derived by means of a diagram technique for classical ionized gases, which explicitly takes into account the many-body character of the long range Coulomb "collision". A completely analogous derivation for a quantum plasma is given here without detailed calculations. This new equation describes collisions between particles taking into account the polarization of the medium and can be used as a starting point for the calculation of the relaxation time in a degenerate Fermi gas, and hence for all related irreversible processes.

694

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

ON THE DECAY OF LONG-RANGE CORRELATIONS, by I. Prigogine, R. Balescu, and I. M. Krieger. [1960] [2]p. incl. diagrs. (AFOSR-TN-60-1193) [AF 61(052)179] AD 244356 Unclassified

Published in Physica, v. 26: 529-530, July 1960.

The method developed by Prigogine and Basescu (see item no. 689, Vol. IV) is applied to the time variation of the 2-particle distribution function at large separation of the 2-particles. By using the concept of pseudo-diagonal diagrams, a closed equation is obtained for a weakly coupled application. The possible application of this equation may be applicable for homogeneous turbulence problem.

695

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

IRREVERSIBLE PROCESSES IN IONIZED GASES, by R. Balescu. [1959] [12]p. incl. diagrs. refs. [AF 61(052)179] Unclassified

Published in Phys. Fluids, v. 3: 52-63, Jan.-Feb. 1960.

The general theory of irreversible processes, developed by Prigogine and Balescu, is applied to the case of long range interactions in ionized gases. A similar diagram technique permits the systematic selection of all the contributions to the evolution of the distribution function, to an order of approximation equivalent to Debye's equilibrium theory. The infinite series which appear in this way can be summed exactly. The resulting evolution equations have a clear physical significance: they describe interactions of "quasi particles," which are electrons or ions "dressed" by their polarization clouds. These clouds are not a permanent feature, as in equilibrium theory, but have a nonequilibrium, changing shape, distorted by the motions of the particles. From the mathematical point of view, these equations exhibit a new type of nonlinearity, which is very directly related to the collective nature of the interactions. (Contractor's abstract)

696

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

TRANSPORT EQUATION OF A PLASMA, by R. Balescu. [1960] [3]p. incl. diagrs. [AF 61(052)179] Unclassified

Presented at Symposium on Magneto-Fluid Dynamics, Williamsburg, Va. and Washington, D. C., Jan. 18-23, 1960. (AFOSR-303)

Published in Rev. Modern Phys., v. 32: 719-721, Oct. 1960.

Recently, the general theory of irreversible processes in gases has been developed using the diagram technique which permits a treatment of an equation describing the collective effects. This method has

been modified by the introduction of a Yukawa-type potential for the suppressing of the divergence. The equation of evolution of the one-particle momentum distribution is obtained with the aid of the ring diagram. A brief physical interpretation is given in terms of the interaction of electrons dressed by a polarization cloud.

697

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

BINARY CORRELATIONS IN IONIZED GASES, by R. Balescu and H. S. Taylor. [1960] [9]p. incl. diagrs. refs. [AF 61(052)179] Unclassified

Published in Phys. Fluids, v. 4: 85-93, Jan. 1961.

An equation of evolution for the binary distribution function in a classical homogeneous non-equilibrium plasma is derived. It is shown that the asymptotic (long-time) solution of this equation is the Debye distribution, thus providing a rigorous dynamical derivation of the equilibrium distribution. This proof is free from the fundamental conceptual difficulties of conventional equilibrium derivations. Out of equilibrium, a closed formula is obtained for the long living correlations, in terms of the momentum distribution function. These results should form an appropriate starting point for a rigorous theory of transport phenomena in plasmas, including the effect of molecular correlations. (Contractor's abstract)

698

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

APPROACH TO EQUILIBRIUM OF A QUANTUM PLASMA, by R. Balescu. [1960] [6]p. incl. diagrs. refs. [AF 61(052)179] Unclassified

Published in Phys. Fluids, v. 4: 94-99, Jan. 1961.

The treatment of irreversible processes in a classical plasma (Phys. Fluids, v. 3: 52, Jan.-Feb. 1960) is extended to a gas of charged particles obeying quantum statistics. The various contributions to the equation of evolution for the reduced 1-particle Wigner function are written in a form analogous to the classical formalism. The summation is then performed in a straightforward manner. The resulting equation describes collisions between particles "dressed" by their polarization clouds, exactly as in the classical situation. (Contractor's abstract)

699

Free U of West Berlin (Germany).

DISSOCIATION CROSS SECTIONS, by S. Grossmann. Nov. 1960 [99]p. incl. diagrs. tables, refs. (AFOSR-224) (AF 61(052)217) AD 251236; PB 155423 Unclassified

The inelastic scattering between hydrogen molecules and hydrogen atoms is investigated. From the calculations for some special configurations of the 3 hydrogen atoms a general spherically symmetric ansatz for the 2 lowest potential-hypersurfaces of the H_3 problem is derived. The quantum-mechanical 3-body scattering problem is discussed and the scattering cross section σ_{01} in the frame of the distorted waves approximation by different approximation methods for the partial wave equation is investigated.

700

Free U. of West Berlin (Germany).

A DERIVATION OF BOLTZMANN EQUATION WITH THE HELP OF AN ASSUMPTION OF DETERMINACY, by G. Ludwig. [1960] 34p. (Technical rept. no. 1) (AFOSR-TN-60-1405) (AF 61(052)239) AD 246970; PB 153311 Unclassified

Also published in Physica (Netherlands), v. 30: 479-492, Mar. 1964.

A derivation of the classical Boltzmann collision equation is given, proceeding from Boltzmann's original interpretation of the density function $f(\vec{r}, \vec{v}, t)$. The essential assumption together with well known ones, already formulated in other derivations, are that $f(\vec{r}, \vec{v}, t)$ is determined by $f(\vec{r}, \vec{v}, t-\tau)$ alone (and for instance not only if the whole earlier course in time is given), and that f(r, v, t) proceeds in a determinate manner.

701

Free U. of West Berlin (Germany).

REMARKS ON THE VALIDITY OF A TEST FOR EVOLUTION, by K. Just and R. Wielen. May 3, 1960 [8]p. incl. tables. (Technical note no. 1) (AFOSR-TN-60-916) (AF 61(052)335) AD 241913; PB 150348 Unclassified

The chief aim of this report is to study the validity of the steady state theory. Some of the pertinent aspects of the problem which are taken into consideration are Abell's criterion of compactness, galactic obscuration and the possibility of a scale error. It is shown that a former test against a steady state of the universe holds even when the used clusters of galaxies are catalogued with certain systematic errors.

702

Fribourg U. Dept. of Physics (Switzerland).

GAS BUBBLE CHAMBER RESEARCH. Final technical

rept. [1960] [36]p. incl. diagrs. refs. (AFOSR-TR-60-25) (AF 61(514)1262) AD 233271; PB 145852
Unclassified

Research was started to develop a workable metastable thermodynamical system for the detection of the path of high energetic ionizing particles in a dense medium. The supersaturated gas-liquid system appeared promising. This system was obtained by dissolving a gas under pressure in a liquid and by subsequent pressure release. The development of the gas bubble chamber technique is described.

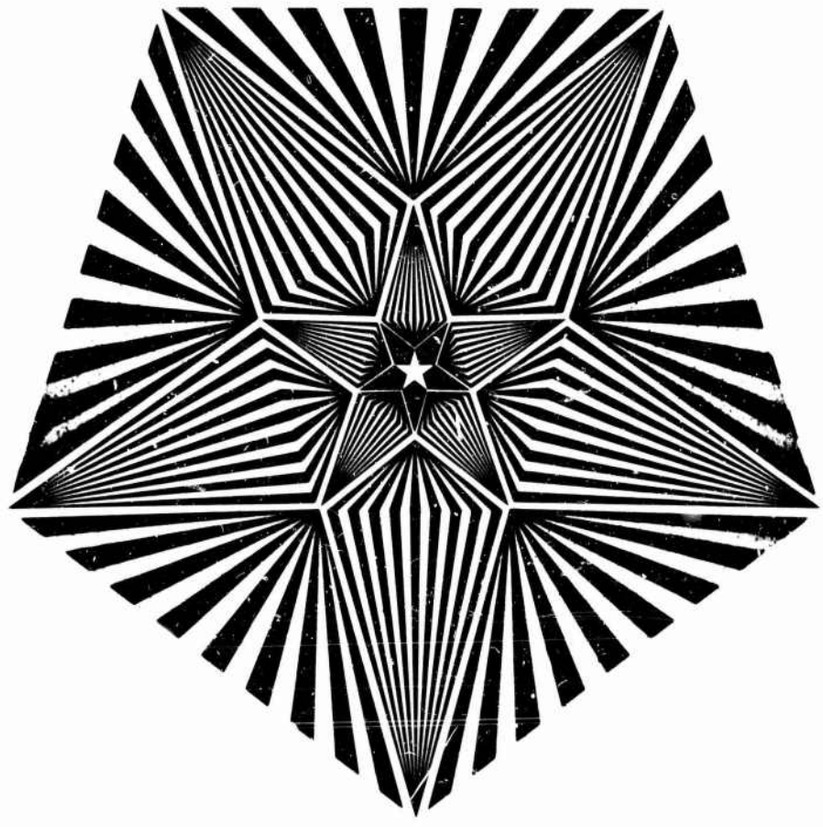
703

Fribourg U. Dept. of Physics (Switzerland).

CONTROLLED SENSITIVITY BUBBLE CHAMBER WITH STABILIZED FINAL PRESSURE, by B. Hahn, A. W. Knudsen, and E. Hugentobler. [1959] [10]p. incl. diagrs. [AF 61(514)1262] Unclassified

Also published in Nuovo Cimento, Series X, Suppl., v. 15: 236-245, 1960.

The description of a radiation sensitivity stabilized 2-liter bubble chamber operating with $CBrF_3$ or fluorocarbon gas-liquid mixtures near room temperature is given. Final pressure stabilization have been achieved according to Blinov's method. Flat bottomed pressure pulses 30 msec long and corresponding bubble density plateau with bubble density variations smaller than ±5% have been obtained. The sensitivity of the temperature stabilized chamber is reproducible at any time and can be adjusted instantaneously to the desired bubble density. Accurate bubble counting for particle velocity determinations is possible without reference track in each bubble chamber picture. (Contractor's abstract)



704

General Dynamics Corp. Convair Div., Pomona, Calif.

THERMAL STRESSES IN A PERFORATED SQUARE PLATE, by R. D. Sutherland and S. M. Manville. June 1960, 36p. incl. illus. diagrs. tables. (Rept. no. TM-349-19) (AFOSR-TN-60-840) (AF 49(638)592) AD 242797 Unclassified

The thermal stress problem in a square plate containing a central circular hole is solved using the complex analysis of Muskhelishvili and conformal mapping. A temperature distribution for this configuration is observed experimentally and is used in conjunction with the results of the analysis to calculate the thermal stresses in the plate. The stresses thus obtained are presented as functions of radial and angular displacement throughout the plate. (Contractor's abstract)

705

General Dynamics Corp. Convair Div., San Diego, Calif.

MICROWAVE ENERGY TRANSFER MECHANISMS (Unclassified title), n.a. [Dec. 31, 1960] [237]p. incl. diagrs. tables. (Rept. no. ZPH-074) (AFOSR-144) (AF 49(638)855) Secret

706

General Dynamics Corp. General Atomic Div., San Diego, Calif.

ATOMIC-BEAM STUDIES ON THE FORMATION OF FREE-RADICAL SOLIDS, by R. T. Brackman and W. L. Fite. [1959] [12]p. incl. illus. (AF 49(638)-301) Unclassified

Published in Fourth Internat'l. Symposium on Free Radical Stabilization, Dunbarton Coll., Washington, D. C. (Aug. 31-Sept. 2, 1959), Washington, D. C., Nat'l. Bureau of Standards, 1959, p. C-V-1-C-V-12.

In the study of the formation of atomic-hydrogen solids, modulated-atomic beam techniques have 4 major advantages: (1) Since the electron impact ionization cross sections of atomic hydrogen and of many stable chemical species are known, it is straightforward by means of a mass spectrometer to monitor the beam of particles impinging on a cold surface and thus ascertain the relative proportions; (2) a variety of standard atomic-beam sources exist which produce neutral beams of arbitrary mixtures of atomic and stable species; (3) by using inhomogeneous magnetic analyzers, the atoms impinging on a target can be restricted to a single spin orientation; and (4) reflected-beam techniques can be used to measure directly the probabilities of sticking, reflection, thermal accommodation, and reassociation of atoms in single collisions at a surface. This paper summarizes the results of a number of experiments pertinent to the problem of stabilizing atomic hydrogen at liquid-helium temperature. (Contractor's abstract)

707

General Dynamics Corp. General Atomic Div., San Diego, Calif.

FIRST AIR FORCE OFFICE OF SCIENTIFIC RESEARCH CONTRACTORS MEETING ON CHEMICAL KINETICS OF PROPULSION. PROGRAM AND ABSTRACTS OF PAPERS, San Diego, Calif., Sept. 6-7, 1960 [32]p. (AFOSR-TN-60-1063) (AF 49(638)301) AD 246174 Unclassified

Various aspects of chemical kinetics are discussed. Copies include atom concentrations in low temperature plasma jet, high temperature chemical kinetics produced by shock waves, radical formation and recombination at low temperatures, and reactions of free radicals containing nitrogen.

708

General Dynamics Corp. General Atomic Div., San Diego, Calif.

CONDENSATION OF ATOMIC AND MOLECULAR HYDROGEN AT LOW TEMPERATURES, by R. T. Brackmann and W. L. Fite. [1960] 25p. incl. diagrs. table. (Rept. no. GA-1683) (AFOSR-TN-60-1246) (AF 49(638)301) AD 250781 Unclassified

Also published in Jour. Chem. Phys., v. 34: 1572-1576, May 1961.

With the use of reflected modulated atomic beam techniques, the reflection of hydrogen atoms and molecules at cold surfaces was examined. It was found that at low temperatures (~4°K) hydrogen atoms reflect as atoms with a very high probability. The reflection of hydrogen molecules is strongly dependent upon the amount of water vapor condensed on the target previously to or simultaneously with the H_2. The fact that condensation of stable gases can be affected by simultaneous condensation of water vapor at temperatures exceeding the gases' normal boiling points leads to an application in the form of an extraordinarily inexpenway to produce vacuums in the 10^{-5} mm Hg range. (Contractor's abstract)

709

General Dynamics Corp. General Atomic Div., San Diego, Calif.

CHEMICAL REACTIONS USING MODULATED FREE RADICAL BEAMS (Abstract), by W. L. Fite. 1960 [1]p. (AF 49(638)301) Unclassified

Presented at First AFOSR Contractors meeting on Chemical Kinetics of Propulsion, General Dynamics Corp., General Atomic Div., San Diego, Calif., Sept. 6-7, 1960. (AFOSR-TN-60-1063; AD 246174)

The principal reactions which have been sought to date are $O + H_2 \rightarrow OH + H$ and $D + H_2 \rightarrow HD + H$. The experiments have been able only to set high upper limits

on these reactions of 10^{-15} and 10^{-14} cm^2, respectively. Unanticipated sources of noise have entered the experiments, arising from impurity problems. The chemical kinetic experiment of principal concern here is designed to measure two-body reaction across sections in the gas phase and is performed in the crossed beam configuration used by Taylor and Datz to study K + HBr → KBr + H. This paper reviews the crossed beam experiments performed up to the present and discusses the noise problems which have been encountered.

710

General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio.

THERMODYNAMIC AND ELECTRICAL PROPERTIES OF MERCURY VAPOR AT PRESSURES BELOW ATMOSPHERIC AND HIGH TEMPERATURES, by A. Sherman and F. Martinek. Feb. 1959-Feb. 1960 [40]p. incl. diagrs. table, refs. (AFOSR-TN-60-657) (AF 49(638)243) AD 240652; PB 149815
Unclassified

Presented at Conf. on Phys. Chem. in Aerodynamic Space Flight, Pennsylvania U., Sept. 1-3, 1959.

Also published in Planetary and Space Sci., v. 3: 271-282, Feb. 1961.

The thermodynamic properties of mercury vapor have been calculated for temperatures up to 15,000°K and pressures between 1 and 10^{-4} atmospheres. The first ionization is shown to be essentially complete at 15,000°K. At the lower pressures the ionization is completed earlier. Corrections have been included to account for the lowering ionization potential and the finite limit of the electronic term series. The largest corrections occur at the higher pressures, the correction at 10^{-4} atmospheres being negligible. The electrical conductivity is determined in the presence and absence of a magnetic field. The corrections due to a 10,000 gauss field, assuming Hall currents are free to flow, are found to be very important at low pressures. In addition, the conductivity which previously rose monotonically, can now have a maximum at the lower pressures. (Contractor's abstract)

711

General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio.

A HIGH TEMPERATURE TUNNEL USING PLASMA GENERATORS, by H. F. Cassidy, F. Martinek, and M. L. Ghai. Dec. 1960 [41]p. incl. illus. diagrs. (AFOSR-TN-60-1412) (AF 49(638)243) AD 250732
Unclassified

This report summarizes some of the investigations performed to develop an electrothermal heat transfer tunnel. The primary objective is to provide a test environment suitable for steady state heat transfer research at temperatures above the limitations of conventional test apparatus. Studies indicate that a gas tunnel using arc plasma generation can operate successfully and generate continuous high temperature gas flows suitable for heat transfer research. Desired temperature and pressure profiles and steady state operation have been obtained. The measurement of total temperatures by thermometry has been accomplished at temperatures of 5500°R.

712

General Electric Co. General Electric Research Lab., Schenectady, N. Y.

OBSERVATIONS OF ADSORPTION ON AN ATOMIC SCALE, by G. Ehrlich and F. G. Hudda. [1960] [2]p. incl. illus. (AFOSR-TN-60-966) [AF 49(638)791] AD 435175
Unclassified

Also published in Jour. Chem. Phys., v. 33: 1253-1254, Oct. 1960.

A field ion microscope was used. A clean W point of radius 450A was used at a pressure of 5×10^{-11} mm. The close-packed rows of the (111) planes and the (211) planes were resolved. When small amounts of N_2 were introduced into the microscope, adsorption was observed only on the high-index planes. The smooth and close-packed planes such as the (110), (211), and (130) were entirely devoid of adsorbed material. It is concluded that the non-uniform distribution arises from differences in the dissociation rate and not from non-uniformities in the gas supply or the selective effect of the high field of adsorbed material.

713

General Electric Co. General Electric Research Lab., Schenectady, N. Y.

PROCEEDINGS OF INTERNATIONAL CONFERENCE ON THE FERMI SURFACE OF METALS, Cooperstown, N. Y., Aug. 22-24, 1960, ed. by W. A. Harrison and M. B. Webb. New York, Wiley and Sons, 1960, 356p. incl. illus. diagrs. tables, refs. (AFOSR-395) (AF 49(638)926) L. C. QC176. J5, 1960. Unclassified

This book contains the papers and discussions of an international conference on the Fermi Surfaces of Metals held at Cooperstown, N. Y. on Aug. 22-24, 1960. It summarizes the remarkable progress of the last few years in the understanding of the electronic properties of metals, clarifies the current status of the science, and defines the problems which will require solution. The contributions of 90 scientists from 7 countries are included in the book, and they afford both general discussion and specific detailed information on the size and shape of Fermi surfaces. Such topics as the importance of many-body effects in both theory and experiment, the diverse experimental and theoretical information on noble metals, progress in the understanding of polyvalent metals, and the electronic structure of alloys are given special prominence.

714

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

A NEW SET OF VARIABLES FOR ASTRONOMICAL PROBLEMS, by A. M. Garofalo. [1959] 15p. (Rept. no. R60SD343) (AFOSR-TN-60-637) (AF 49(638)814) AD 242257 Unclassified

Also published in Astronom. Jour., v. 65: 117-121, Apr. 1960.

The equations of motion for a particle A under the gravitational influence of n other particles in a system of reference with origin at one of these particles B are written in terms of new variables. These have the classical property of being constant if only the influence of B on the motion of A is considered. They have the advantage of not introducing any new singularities if the instantaneous conic of A relative to B does not degenerate into a straight line. (Contractor's abstract)

715

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

EQUATIONS FOR THRUST PROGRAMS, by V. G. Szebehely. June 1960, 23p. (AFOSR-TN-60-815) (AF 49(638)814) AD 242257; AD 611465 Unclassified

Also published in Proc. Eleventh Internat'l. Astronaut. Congress, Stockholm (Sweden), (Aug. 15-20, 1960), Vienna, Springer-Verlag, v. 1: 431-443, 1961.

A new analytical technique is presented which considers guidance and the determination of thrust programs as inverse trajectory problems. The trajectory of a body is uniquely determined — excepting trivial special cases — if the force field and the initial conditions are given. The inverse problem, i.e. determining the force acting on a vehicle which, with given initial conditions will describe a given orbit or trajectory does not possess unique solution. The force acting on the vehicle is separated into two parts, one representing the given gravitational field, the other — to be determined — is associated with the vehicle produced propulsion, orbit correction or guidance force. It is shown that for a predetermined orbit the determination of this second force requires the solution of differential equations. Several sets of functions are obtained satisfying the problem and several special examples, related to lunar and interplanetary missions, are mentioned. Optimization techniques emerging naturally are discussed. The technique is applied to the problem of solar sails with variable sail angle and to the restricted three body problem. (Contractor's abstract)

716

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

EFFECTS OF END CURRENT LOOPS ON THE VELOCITY PROFILE IN A MAGNETOHYDRODYNAMIC CHANNEL, by A. W. Carlson and G. W. Sutton. Dec. 1960, 33p. incl. diagrs. table. (Rept. no. R60SD439) (AFOSR-TN-60-1183) (AF 49(638)914) AD 248631; PB 153835 Unclassified

The variation of the Lorentz forces in the entrance region of an magnetohydrodynamic channel causes the velocity of the fluid to increase near the walls of the channel and to decrease near the center. The ratio of the change in velocity is directly proportional to the dimensionless parameter $\frac{\sigma B \Phi_0}{\rho \quad 2}$. The solutions obtained are valid only for values of $\frac{\sigma B \Phi_0}{\rho \quad 2}$ less than about 0.25. For this value, the maximum change in velocity is 10%, which occurs adjacent to the electrodes.

717

General Electric Co. [Space Sciences Lab., Philadelphia, Pa.]

EFFECTS OF CURRENT LOOPS ON THE INVISCID VELOCITY PROFILE IN A TWO-DIMENSIONAL MAGNETOHYDRODYNAMIC CHANNEL (Abstract), by A. W. Carlson and G. W. Sutton. [1960] [1]p. [AF 49(638)914] Unclassified

Presented at meeting of the Amer. Phys. Soc., Johns Hopkins U., Baltimore, Md., Nov. 21-23, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 208, Mar. 20, 1951.

The effects of end current loops on the velocity profile in a 2-dimensional magnetohydrodynamic incompressible, inviscid channel flow has been investigated. The magnetic field and electrodes voltage are assumed constant for all $x > 0$; for $x < 0$ the channel walls are assumed to be nonelectrical conductors and the magnetic field is zero. A nonuniform electric current field exists in the region about $x = 0$; these interact with the magnetic field to cause a nonuniform Lorentz force. The net result is a decrease in velocity at the center line of the channel and an increase of velocity near the electrodes. The changes in velocity are proportional to the magnetic interaction parameters; when this is equal to 0.25, the maximum percentage change in the velocity profile is 10%.

718

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

A NOTE ON THE THERMAL DIFFUSION RATIO IN

DISSOCIATED AIR, by S. M. Scala. Nov. 1960, 19p. incl. diagr. tables, refs. (AFOSR-21) (AF 49(638)-931) AD 250672 Unclassified

The mechanism of thermal diffusion and approximations to the thermal diffusion ratio in binary mixture dissociated air are presented. The following conclusions are arrived at mathematically: (1) When external forces are neglected, the diffusion flux vector yields contributions due to ordinary (concentration) diffusion, pressure diffusion, and thermal diffusion, and (2) The thermal diffusion ratio is dependent upon gas composition, temperature, ratio of molecular masses and the intermolecular force law, but these effects are separable. For binary mixture dissociated air, a simple approximate analytical expression can be derived for K_T in the form: $K_T = -X_1 (1-X_1) \cdot f(T^*) \cdot f(X_1, T^*)$ where X_1 is the mole fraction of atoms and T^* is the Boltzmann reduced temperature.

719

General Electric Co. [Space Sciences Lab.] Philadelphia, Pa.

AERODYNAMIC FORCES DUE TO HYPERSONIC VISCOUS FLOW (Abstract), by L. Talbot, C. Studerus, and S. M. Scala. [1960] [1]p. [AF 49(638)931] Unclassified

Presented at meeting of the Amer. Phys. Soc., Johns Hopkins U., Baltimore, Md., Nov. 21-23, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 214, Mar. 20, 1961.

Interest in the aerodynamic stability of bodies during high-altitude hypersonic flight has produced a need for information on how the aerodynamic forces are altered by the appearance of large viscous effects. These effects are particularly important for sustained hypersonic flight. In this paper, consideration is given to the problem of estimating the axial force, normal and pitching moment coefficients produced by viscous shear stress, and induced pressures on the spherical nose of a hypersonic vehicle when the flow over the body is asymmetric. Exact solution of the hypersonic laminar continuum boundary layer equations were first obtained. These were then utilized to determine boundary layer characteristics; such as the nominal, displacement, and momentum thicknesses as well as the shear stress acting over the surface. General relationships also were derived which yielded the separate contributions of the shear forces and of the induced pressures to the viscous aerodynamic forces when the vehicle is at an angle of attack to the free stream. The exact boundary layer solutions were then introduced into these relationships. The calculations were performed over a wide range of hypersonic flight conditions, and the results are presented in a useful parametric form.

720

General Mills, Inc., Minneapolis, Minn.

GROWTH TWINS IN INDIUM ANTIMONIDE, by R. K. Mueller and R. L. Jacobson. Dec. 1960 [5]p. incl. illus. (AFOSR-TN-60-1378) (AF 49(638)628) AD 456498 Unclassified

Also published in Jour. Appl. Phys., v. 32: 550-551, Mar. 1961.

Crystals of indium antimonide grown in a horizontal zone melting furnace in opposite <110>, <111>, and <211> directions is presented to demonstrate the preferential occurrence of growth twins in this material. Twinning occurs almost exclusively on only the {111} planes which expose a B surface to the melt during growth. The preferential occurrence is related to the inherent characteristics of the A and B surfaces. The good growth characteristics of InSb in a B <111> direction is considered in relation to the observed twinning behavior. (Contractor's abstract)

721

Genoa U. (Italy).

IONIZATION MEASUREMENTS IN GAS BUBBLE CHAMBER AND STUDY OF NUCLEATION PROCESSES AND GROWTH DYNAMICS OF GAS-BUBBLE IN STRONGLY OVERSATURATED GAS-LIQUID SOLUTIONS, by P. E. Argan, A. Gigli and others. Final rept. June 1959-July 1960. Nov. 14, 1960 [36]p. incl. illus. diagrs. tables. (AFOSR-TR-60-184) (AF 61-(052)285) AD 253268 Unclassified

A one liter working volume gas bubble chamber was exposed to the gamma ray beam of the 31 mev betatron and measurements and calculations were made to determine the energy loss of fast electrons. The design and construction of a 15 liter working volume gas bubble chamber is considered for use with a 1100 mev electronsynchrotron to elucidate some points regarding the energy loss of fast particles in sensitive gas-liquid mixtures of various natures. The characteristics of some of these mixtures having peculiar properties, essentially with regard to their stopping power and their efficiency in the conversion of high energy gamma rays are investigated.

722

Genoa U. Neurosurgical Clinic (Italy).

SPONTANEOUS AND INDUCED ELECTROENCEPHALOGRAPHIC ACTIVITY DURING PHYSIOLOGICAL SLEEP OF THE CAT, by G. F. Rossi, T. Hara and others. Oct. 25, 1960, 3p. (Technical note no. 1) (AFOSR-350) (AF 61(052)461) AD 257533 Unclassified

Recent experimental work has shown that in the cat the deepest stage of sleep is electroencephalographically characterized by low voltage fast rhythms, similar to those occurring during wakefulness, and by

complete disappearance of muscular tonus. This has been fully confirmed by several findings obtained in the laboratory. The present research has been undertaken with the aim of studying the nervous mechanisms underlying this deepest sleep. More particularly, experiments have been performed to study the mechanisms responsible for the desynchronization of the electrocortical activity characterizing it. (Contractor's abstract)

723

Genoa U. Neurosurgical Clinic (Italy).

[PHYSIOPATHOLOGICAL INTERPRETATION OF THE MECHANISMS OF INSURGENT SLEEP DURING DRIVING] Interpretazione fisiopatologica dei meccanismi del sonno insorgente durante la guida, by L. Perria and G. F. Rossi. [1960] [4]p. (AFOSR-367) (AF 61(052)461) Unclassified

Also published in Proc. Congresso di Medicina del Traffica, San Remo, Nov. 1960, p. 811-814.

A physiological basis is sought for the known manifestations of sleep which drivers exhibit in definite driving conditions, an analogy is developed from the observation made by Pavlov relating to the tendency of the experimental animal to fall asleep when the interval between the stimuli is long or when the stimuli are monotonously repetitive. The results ascribe the characteristic property of sleep inducing to a stimulus to which a subject has become habituated. Direct or indirect electrical stimulation is seen to have this sleep inducing effect.

724

George Washington U. Dept. of Chemistry, Washington, D. C.

THE REACTION BETWEEN METALLIC POTASSIUM AND CARBON MONOXIDE. I. PRECURSORS OF POTASSIUM SALT OF HEXAHYDROXYBENZENE, by W. F. Sager, A. Fatiadi and others. July 5, 1960 [11]p. incl. diagrs. table. (AFOSR-TN-60-653) (AF 49(638)325) AD 239216; PB 148881 Unclassified

The reaction between metallic potassium and carbon monoxide is found to proceed according to the following stage: $K + CO \rightarrow (K_3C_2O_2)_n \rightarrow (KCO)_n + CO \triangleq K_6C_6O_6$ measurements of heats of fusion, melting points and magnetic susceptibilities on the reacting compounds indicate the formation of two intermediary products of empirical formulae $K_3C_2O_2$ and KCO.

725

Georgetown U. Dept. of Physics, Washington, D. C.

POWER SERIES EXPANSIONS OF VIBRATIONAL POTENTIALS. I. THE HEITLER-LONDON POTENTIAL FOR H_2, by C. L. Beckel. [1960] [2]p. incl. tables. (AFOSR-3107) [AF-AFOSR-60-1) AD 445177 Unclassified

Published in Jour. Chem. Phys., v. 33: 1885-1886, Dec. 1960.

A simple model of a covalent vibrational potential, the Heitler-London potential for molecules H, was expanded in a Dunham series.

726

Georgetown U. Dept. of Physics, Washington, D. C.

POWER SERIES EXPANSIONS OF VIBRATIONAL POTENTIALS. II. TWO CLASSICAL POTENTIALS FOR IONIC MOLECULES, by E. J. Finn and C. L. Beckel. [1960] [2]p. incl. tables. (AFOSR-3127) (AF-AFOSR-60-1) AD 613800 Unclassified

Also published in Jour. Chem. Phys., v. 33: 1887-1888, Dec. 1960.

Vibrational properties associated with 2 simple ionic potentials are obtained by means of Dunham's power technique and are applied to 3 alkali halides and 2 indium monohalides. The first ionic potential consisted of an exponential repulsion term and a $1/r$ Coulomb attraction term. The second was of a potential that retained these two terms and added an attractive $1/r^4$ polarizability term. These ionic potentials lead to very slow convergence of vibrational levels. Both ionic potentials, when expanded in a Taylor series about r_e, converge only in the range $0 < r < 2r_e$.

For heavy molecules such as the alkali and Group III monohalides, Dunham's expansion has rapidly converging terms and is useful for a large number of vibrational levels.

727

Georgetown U. [Medical Center] Washington, D. C.

RECORDING OF BIOELECTRONIC SIGNALS FOR DIGITAL COMPUTER ANALYSIS, by H. Zimmer. Oct. 1960 [10]p. incl. diagr. (AFOSR-TN-60-1029) (AF 49(638)487) AD 243629 Unclassified

Also published in Thirteenth Annual Conf. on Electrical Techniques in Medicine and Biology, Washington, D. C. (Oct. 31-Nov. 2, 1960), New York, L. Winner, 1960, p. 42-43.

The possibility of preparing psychophysiologic information by digital computer is investigated. The optimal means and locus of translating analog channels into digital information is determined by successive sampling of all channels. This is done by an electric multiplexer and the transformation of their respective voltages into digital information by a single analog to digital (A-D) converter. The device has been used to collect and edit information on various physiological measurements.

728

Georgetown U. [Medical Center] Washington, D. C.

AN INFORMATION PROCESSING ANALOG OF INTRAPERSONAL OPERATIONS, by H. Zimmer. [1960] [13]p. incl. table, refs. (AFOSR-839) [AF 49(638)487] Unclassified

Also published in Neuropsychiat., v. 6: 17-29, 1960.

A persisting set of interrelations among the parts of a whole that determines the pattern of energy interchange among the parts, the pattern remaining the same within wide variations of the level of energy called a dynamic system has been devised. Hostility was chosen as an example of psychodynamic variables in order to simplify the task of setting up a system of this sort. There are indications that hostility conflicts are present to some extent at all levels of awareness of the individual. The important data to be derived from energy level include all manifestations of hostility and all possible reactions or processes in any way related to them. It is this attempt at inclusiveness and totality which may permit the eventual description of an operating, functioning system.

729

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.

DRIFT TUBE-MASS SPECTROMETER FOR STUDIES OF THERMAL-ENERGY ION-MOLECULE REACTIONS, by E. W. McDaniel and D. W. Martin. June 20, 1960, 35p. incl. illus. diagrs. refs. (Technical rept. no. 3) (AFOSR-TN-60-661) (AF 18(600)1524) AD 239337; PB 148965 Unclassified

Apparatus has been developed for the mass spectrographic study of ion-molecule reactions occurring under gas-kinetic conditions at thermal energies. Ions are produced inside a two-foot-long drift space containing gas at a pressure of up to 0.7 mm Hg. The ions diffuse down the drift tube under the action of a weak electric field and pass through a small aperture at the end into a field-free, two-stage differential pumping chamber. From the second stage of this chamber the ions enter a 60° magnetic deflection mass spectrometer. The number of ion-molecule collisions in the drift tube may be varied over a wide range by changing the source position and the gas pressure, and information concerning the nature and probability of various reactions is revealed by the resulting changes in mass spectra. (Contractor's abstract, modified)

730

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.

LANGEVIN'S THEORY OF THE MOBILITY OF GASEOUS IONS, by E. W. McDaniel. Aug. 1, 1960, 49p. incl. diagrs. (Technical rept. no. 4) (AFOSR-TN-60-865) (AF 18(600)1524) AD 242566 Unclassified

This report consists of an English translation of the main body of Paul Langevin's classic paper on the mobility of gaseous ions entitled Une Formule Fondamentale de Théorie Cinétique (Ann. Chim. et Phys., Series 8, v. 5: 245-288, 1905). The historical introduction in the original paper has been omitted in the translation. An appendix dealing with polarization attraction of molecules by ions has been added and a number of changes have been made in notation and terminology in conformity with modern convention. Misprints in several equations have been corrected. (Contractor's abstract)

731

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.

THE TRANSPORT PROPERTIES OF A FULLY IONIZED GAS. I. A QUANTAL STUDY OF DIFFUSION AND VISCOSITY CROSS SECTIONS FOR A SCREENED COULOMB POTENTIAL, by M. R. C. McDowell and G. Peach. Sept. 1, 1960, 61p. incl. diagrs. tables, refs. (Technical rept. no. 5) (AFOSR-TN-60-945) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1524 and National Science Foundation) AD 245157; PB 152789 Unclassified

Also published in Phys. Fluids, v. 4: 1332-1341, Nov. 1961.

Born's approximation and the Massey-Mohr approximation are used to obtain quantum mechanical values of the diffusion and viscosity cross sections Q_D and Q_η for a screened coulomb potential. The parameters are chosen to represent an ionized gas with $10^8 \leq n_e \leq 10^{18}$, where n_e is the electron density, and $5 \times 10^3 \leq T_e \leq 10^7$ °K where T_e is the temperature. The scattering phase shifts are also evaluated and compared with those obtained from direct numerical integration of the scattering equation. Born's approximation to the phase shift is employed in a Faxen-Holtsmark type analysis to give more accurate values of the cross sections at low T and large n_e. The results are used to discuss the behavior of the electrical conductivity of a fully ionized gas. At high temperatures they are in close agreement with earlier workers, but predict a different temperature dependence if $(\frac{T}{n_e})$ is small. (Contractor's abstract, modified)

732

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.

IONIZATION OF LITHIUM BY FAST PROTONS AND ELECTRONS, by M. R. C. McDowell and G. Peach. [1960] [5]p. incl. diagrs. refs. (AFOSR-625) (AF 18(600)1524) AD 255603 Unclassified

Also published in Phys. Rev., v. 121: 1383-1387, Mar. 1, 1961.

Born's approximation is used to calculate the cross sections for ionization of lithium by fast protons (<1mev) and electrons (<1 kev). The electron impact results are in good agreement with those obtained by Seaton's method from experimental photoionization data. The maximum cross section for proton impact is $1.1\pi a_0^2$ at 20 kev. (Contractor's abstract)

733

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.

SOURCE OF THERMAL IONS FOR USE IN GASES AT HIGH PRESSURES, by E. W. McDaniel and D. W. Martin. [1960] [1]p. incl. diagr. (AFOSR-J88) [AF 18(600)1525] AD 400609 Unclassified

Also published in Rev. Scient. Instr., v. 31: 660, June 1960.

A method of generating thermal ions which requires the generation of microampere currents of thermal ions in a drift tube containing any of several gases at pressures of about 1000μ has been described. This technique utilizes a thoriated V-shaped filament as a thermionic emitter which is located 1/4 in. from and parallel to a helical wire anode, 3/4 in. in diameter and 2 in. in length. The source is positioned between two adjacent guard-ring-type electrodes in the drift tube. The dc level of the filament is intermediate between the potentials of the two electrodes. All ionization is produced very near the anode, and the resulting ions are rapidly thermalized as they drift out of the high field region near the anode to proceed down the drift tube.

734

Georgia Inst. of Tech. [Engineering Experiment Station], Atlanta.

APPARATUS FOR MASS SPECTROGRAPHIC STUDIES OF LOW ENERGY ION-MOLECULE REACTIONS (Abstract), by E. W. McDaniel and D. W. Martin. 1960] [1]p. [AF 18(600)1524] Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Pubilshed in Buli. Amer. Phys. Soc., Serles II, v. 5: 380, June 15, 1960.

Phenomena such as charge transfer and ionic clustering and dissociation play an important role in gaseous electronics. An instrument constructed for the study of such reactions at very low (down to thermal) energies is described. Positive ions are produced in a thermionic source utilizing a thoriated iridium filament which is located inside a 3-ft-long drift tube containing gas at 0.01-1.0 mm Hg. The ions drift down the tube under "low-field" conditions and pass through a small aperture at the end into a field-free, 2-stage differential pumping chamber. From the second stage of this chamber the ions enter a 60° magnetic mass spectrometer. The number of ion-molecule collisions in the drift tube may be varied over a wide range by moving the ion source along the tube and by changing the drift tube pressure, and reaction cross sections are estimated from the resulting changes in mass spectra. Data obtained with this apparatus will be presented.

735

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.

IONIZATION CROSS SECTIONS FOR PROTONS ON HYDROGEN GAS IN THE ENERGY RANGE 0.15 TO 1.10 MEV, by J. W. Hooper, E. W. McDaniel and others. [1960] [5]p. incl. diagrs. [AF 18(600)1524] Unclassified

Published in Phys. Rev., v. 121: 1123-1127, Feb. 15, 1961.

Measurements have been made of the ionization cross section for protons incident on hydrogen gas in the energy range 0.15-1.10 mev. The experimental cross section in this region can be represented by $\sigma_i = (3.45 \pm 0.20)E^{-0.874 \pm 0.010)} \times 10^{-17}$ cm^2/ molecule, where E is the incident proton energy in mev. The experimental results are in excellent agreement with a Born approximation calculation, which is discussed. (Contractor's abstract)

736

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.

CONVECTIVE FLOW DUE TO ACOUSTIC VIBRATIONS IN HORIZONTAL RESONANT TUBES, by T. W. Jackson and H. L. Johnson. Final rept. Mar. 1960, 35p. incl. illus. diagrs. refs. (AFOSR-TR-60-52) (AF 49(638)459) AD 233970; PB 146432 Unclassified

The convective flow due to acoustic vibrations in a horizontal resonant tube is investigated. The flow was made visible by illuminating smoke particles in the air by means of a 200 watt-sec flash filament source and recording the motion photographically. Sequential photographs of the flow at different sound pressure levels and frequencies were obtained which indicate that the sound effect on the flow is very complicated and not readily analyzed. The smoke patterns which are similar to those noted in cloud formations in the atmosphere are also found to be influenced by external noises.

737

Georgia Inst. of Tech. Engineering Experiment Station, Atlanta.

COUNTER ADAPTOR AND FURNACE FOR WEISSENBERG CAMERA, by R. A. Young. Oct. 1960

[36]p. incl. illus. diagrs. (Technical note no. 1) (AFOSR-TN-60-1462) (AF 49(638)624) AD 253799; PB 155588 Unclassified

Presented at Ninth annual Conf. on Application of X-ray Analysis, Denver, Colo., Aug. 10-12, 1960.

A furnace device which blows hot air along the crystal mounting axis has been mounted directly on a Weissenberg camera base. The counter-adaptor and furnace have been used to advantage both separately and together. At 650°C ± 1°C, there is a cross-sectional region of minimum dimension greater than 1.5 mm over which the temperature is uniform to within 2°C. The particular mounting of the furnace described makes it possible to examine both the isothermal relative intensities and the temperature dependence of the intensities of all reflections (with 2θ less than about 150°) in the zero and first few upper layers and to carry out crystal alignment, over the temperature range from room temperature to 700°C, without change in the crystal to furnace relationship and without obstruction of the x-ray beams. (Contractor's abstract)

738

Georgia U. [Dept. of Sociology] Athens.

TECHNOLOGICAL CHANGE AND THE ORGANIZATION MAN: PRELIMINARY CONCEPTUALIZATION OF A RESEARCH PROJECT, by R. V. Bowers, R. G. Brown, and C. D. Bryant. [1960] [11]p. incl. refs. (AFOSR-TN-60-1153) (AF 49(638)804) Unclassified

Presented at Fifty-fifth annual meeting of the Amer. Socioi. Assoc., New York, Aug. 1960.

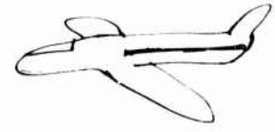
Also published in Socioi. Inquiry, v. 32: 117-127, Winter, 1962.

The impact of change on the organization man has been studied and found to be influenced by several variables. In regard to the change itself, several factors must be considered, including the speed with which the change is introduced, the number of persons the change will affect, what the probable effects on employee effort and habits will be, and how radical the change is. The personality of each individual is also considered as one of the intervening variables in relation to change. Specific variables in this area include achievement-affiliation motivations, inner- and other-directedness, and cosmopolitan-local roles.

Guggenheim Aeronautical Lab., Pasadena, Calif.
see California Inst. of Tech. Guggenheim Aeronautical Lab., Pasadena.

Guggenheim Jet Propulsion Center, Pasadena, Calif.
see California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

Gustaf Werner Inst. of Nuclear Chemistry (Sweden)
see Uppsala U. Gustaf Werner Inst. of Nuclear Chemistry (Sweden).





Hamilton Coll., Ont. (Canada)
see McMaster U. Hamilton Col., Ont. (Canada).

739

Harvard U. [Cruft Lab.] Cambridge, Mass.

NATURAL CONVECTION ABOVE FIRES, by M. P. Murgai and H. W. Emmons. [1960] [14]p. incl. diagrs. table. (AFOSR-TN-60-54) (AF 49(638)29) AD 246041 Unclassified

Also published in Jour. Fluid Mech., v. 8: 611-624, Aug. 1960.

The turbulent natural convection above fires in a dry calm atmosphere with a constant lapse rate has been the subject of several recent investigations. The present analysis presents solution curves from which the natural convection may be computed over a fire of arbitrary size in an atmosphere with arbitrary lapse-rate variation. The independent parameters of the fire size, energy release rate (buoyance), momentum release rate and atmospheric lapse rate are given over the expected range of values. The arbitrary variation of lapse rate is thus calculable as piecewise constant. (Contractor's abstract)

740

Harvard U. [Cruft Lab.] Cambridge, Mass.

RADIATIVE TRANSFER EFFECTS IN NATURAL CONVECTION ABOVE FIRES, by M. P. Murgai. [1960] [8]p. incl. diagrs. table. (AFOSR-TN-60-335) (AF 49(638)29) AD 436677 Unclassified

Also published in Jour. Fluid Mech., v. 12: 441-448, Mar. 1962.

Results are described of examining the influence of radiative heat transfer on turbulent natural convection above fires in an atmosphere of constant potential temperature, under both the opaque and transparent approximations. The former case reduces to that of no radiative transfer. For the latter case, the initial fire size, the energy release rate (initial temperature difference), and the absorption coefficient have been regarded as independent parameters. The solution curves presented cover a range over which these parameters are expected to vary in practice. (Contractor's abstract)

741

Harvard U. [Cruft Lab.] Cambridge, Mass.

CONTACT POTENTIAL MEASUREMENTS ON CLEANED GERMANIUM SURFACES, by A. B. Fowler. [1958] [3]p. incl. diagrs. refs. (Sponsored jointly by Air Force [Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616]) Unclassified

Published in Jour. Appl. Phys., v. 30: 556-558, Apr. 1959.

The contact potential of the (110) face of the n and p regions of an n-p germanium crystal was measured in a vacuum of less than 10^{-9} mm Hg using a Kelvin bridge technique. The n and p regions were so doped that their resistivities were 0.058 and 0.33 ohm-cm, respectively. If there had been no surface states the difference in work function would have been 0.34 ev. The argon-cleaned surface exhibited a difference of 0.002 (±0.004) ev. An exposure of as little as 0.4×10^{-7} mm-min of oxygen increased the difference to 0.013 ev. A difference as large as 0.018 ev was observed after a 28×10^{-7} mm-min exposure. After 56×10^{-7} mm-min the difference was reduced to 0.000 (±0.005) ev. These results are discussed in terms of several surface state distributions. (Contractor's abstract)

742

Harvard U. [Cruft Lab.] Cambridge, Mass.

SPECIFIC HEAT OF SOME RARE EARTH IRON GARNETS AND YIG AT LOW TEMPERATURES, by H. Meyer and A. B. Harris. [1959] [2]p. incl. diagr. (Sponsored jointly by Air Force [Office of Scientific Research], Office of Naval Research, and [Signal Corps] under [Nonr-186616]) Unclassified

Presented at [Fifth] Conf. on Magnetism and Magnetic Materials, Detroit, Mich., Nov. 16-19, 1959.

Published in Jour. Appl. Phys., Suppl., v. 31: 49S-50S, May 1960.

Heat capacity measurements of the iron garnets of Y, Gd, Er, Ho, and Yb between 1.4°-20°K are presented. Below 5°K, the specific heat of YIG can be represented by the sum of a lattice term proportional to T^3 and the spin wave contribution $2.15 \times 10^{-3} T^{3/2}$ joules/mol-deg. This last term agrees satisfactorily with that calculated from a spin-wave analysis, in which the exchange interaction coefficients were those derived from Pauthenet's magnetization data. The results of the magnetic specific heat of the rare earth ions could be interpreted in terms of a Weiss molecular field acting on these ions. For Gd^{3+} and Yb^{3+}, this field was found to be, respectively, about 3.0×10^5 and 1.5×10^5 oersted below 20°K, in satisfactory agreement with that derived from Pauthenet's data. (Contractor's abstract)

743

Harvard U. [Cruft Lab.] Cambridge, Mass.

RESONANCE MEASUREMENTS IN MAGNETIC GARNETS, by G. P. Rodrigue, H. Meyer, and R. V. Jones. [1959] [7]p. incl. diagrs. tables, refs. [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616] Unclassified

Presented at [Fifth] Conf. on Magnetism and Magnetic Materials, Detroit, Mich., Nov. 16-19, 1959.

Published in Jour. Appl. Phys., Suppl., v. 31: 376S-382S, May 1960.

The effective g value, anisotropy constants, and line widths of single crystals of YIG, GdIG, SmIG, HoIG, ErIG, and YbIG have been measured over a range of temperatures from 1.5°K to 550°K by ferrimagnetic resonance. The temperature dependence of K_1 in both YIG and GdIG is satisfactorily represented by the model of an individual ion subject to a crystalline field in addition to a Weiss molecular field. The g values of HoIG and ErIG appear to be in good agreement with the estimation of Kittel et. al. for a ferrimagnetic system with one sublattice strongly damped. It has been found that SmIG and YbIG do not follow the predictions of the Kittel model, since different relative strengths of exchange and relaxation interactions seem to be involved. (Contractor's abstract)

744

Harvard U. [Cruft Lab.] Cambridge, Mass.

MICROWAVE MODULATION OF LIGHT IN PARAMAGNETIC CRYSTALS, by N. Bloembergen, P. S. Pershan, and L. R. Wilcox. Aug. 1, 1960, 27p. incl. diagrs. refs. (Technical rept. no. 325) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) AD 243873 Unclassified

Also published in Phys. Rev., v. 120: 2014-2023, Dec. 15, 1960.

The considerations of Dehmelt and several other workers about the modulation of light by radiofrequency signals in atomic vapors are extended to paramagnetic solids. It is shown that these materials, driven near a microwave resonance at low temperatures may be used both to create and to detect modulation of light at microwave frequencies. Experimental design criteria are discussed at the hand of two numerical examples, modulated circular dichroism in ruby and modulated Faraday rotation in a broad class of ionic rare earth compounds. Some possible applications of microwave modulated light are reviewed. (Contractor's abstract)

745

Harvard U. Cruft Lab., Cambridge, Mass.

ON THE CONSTRUCTION OF LYAPUNOV FUNCTIONS FOR NONLINEAR SYSTEMS, by K. S. Narendra and Y.-C. Ho. Sept. 15, 1960, 6p. incl. illus. (Technical rept. no. 328) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) AD 243781 Unclassified

An approach is proposed for the construction of Lyapunov functions for general nonlinear systems. This approach transforms the problem of guessing a suitable Lyapunov function to that of determining the intersection of certain sets which can be computed at least in principle. (Contractor's abstract)

746

Harvard U. [Cruft Lab.] Cambridge, Mass.

PRESSURE AND TEMPERATURE DEPENDENCE OF THE Fe^{57} NUCLEAR MAGNETIC RESONANCE FREQUENCY IN FERROMAGNETIC IRON, by G. B. Benedek and J. Armstrong. [1960] [5]p. incl. diagrs. tables, refs. [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616] Unclassified

Presented at [Sixth] Conf. on Magnetism and Magnetic Materials, New York, N. Y., Nov. 14-17, 1960.

Published in Jour. Appl. Phys., Suppl., v. 32: 106S-110S, Mar. 1961.

The pressure dependence of the Fe^{57} nuclear magnetic resonance frequency ν in ferromagnetic ion from 1-10,000 kg/sq cm at -77°C, 0°C, and 84.2°C were measured. From these measurements the volume dependence of ν was obtained, enabling corrections of $\nu(T)_{P=1\ atm}$ measurements for the effects of thermal expansion. By making a similar correction for the effect of thermal expansion on the temperature dependence of the saturation magnetization σ, it was found that at constant volume, the hyperfine coupling constant A in the relation $\nu = A\sigma$ is an explicit function of the temperature. Thus, measurements of the temperature dependence of ν even when corrected to constant volume, do not give accurately the temperature dependence of σ. The results of a theory based on Stoner's collective electron model for the d electrons are presented to account for the temperature dependence of A. (Contractor's abstract)

747

Harvard U. [Cruft Lab.] Cambridge, Mass.

PROTON RELAXATION TIMES IN PARAMAGNETIC SOLUTIONS. EFFECTS OF ELECTRON SPIN RELAXATION, by N. Bloembergen and L. O. Morgan. [1960] [9]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186616) Unclassified

Published in Jour. Chem. Phys., v. 34: 842-850, Mar. 1961.

The proton relaxation time in solutions of paramagnetic ions depends, among other factors, on the relaxation time of the electron spins, τ_s. It is shown that the latter, for ions of the iron group, is determined mostly by the distortion of the hydrated complex by collisions with other water molecules. The theory provides a quantitative explanation for the decrease in T_2 in Mn^{++} (and other) solutions in very high magnetic fields. The experimentally observed field

and temperature dependence of the proton relaxation times, T_1 and T_2, for ions of the iron group is compared with theory and the features which depend on τ_s are stressed. (Contractor's abstract)

748

Harvard U. [Cruft Lab.] Cambridge, Mass.

EFFECTS OF HYDROSTATIC PRESSURE ON THE PARAMAGNETIC RESONANCE SPECTRA OF SEVERAL IRON GROUP IONS IN CUBIC CRYSTALS, by W. M. Walsh, Jr. [1960] [10]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-186616]) Unclassified

Published in Phys. Rev., v. 122: 762-771, May 1, 1961.

The magnetic resonance spectra of Cr^{3+}, Mn^{2+}, Fe^{3+}, and Ni^{2+} present as substitutional impurities in MgO crystals and powders, and of Mn^{2+} in cubic ZnS have been observed as functions of hydrostatic pressure at room temperature. The results are interpreted assuming the local compressibilities to be equal to those of the pure host lattices. The measured volume dependence of the orbital contributions to the magnetic moments of the F-state ions, Cr^{3+} and Ni^{2+}, are consistent with a point-charge model within the experimental error. This simple model can only crudely account for the observed magnitudes of the orbital singlet-triplet splittings, however. The pressure dependences of the cubic field splittings of the S-state ions, Mn^{2+} and Fe^{3+}, are identical in MgO and correspond roughly to a fourth power law if an ionic potential is assumed. The cubic field parameter for Mn^{2+} in ZnS varies half as rapidly with volume. These results are consistent with recent calculations of Powell, Gabriel, and Johnston if it is assumed that the volume dependence of the cubic potentials in these lattices are given by the ionic model though the relative magnitudes are not. The hyperfine structure of the manganese spectra also proves sensitive to sample volume, particularly in the sulfide. The effect may be qualitatively understood in terms of the exchange-polarization theory of the strong electron-nuclear interaction. (Contractor's abstract)

749

Harvard U. Cruft Lab., Cambridge, Mass.

THEORY OF THE DIPOLE ANTENNA AND THE TWO-WIRE TRANSMISSION LINE, by T. T. Wu. Mar. 10, 1960, 43p. incl. illus. refs. (Technical rept. no. 318) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 237670 Unclassified

The properties of the dipole antenna are studied by an approximate procedure that makes use of the Wiener-Hopf integral equation. In particular, the input admittance and the radiation pattern are found. Simple formulas are obtained only when the dipole antenna is more than one wavelength long. The present results thus supplement the existing theories, which are concerned mostly with shorter dipoles. The same procedure is then applied to several related problems. First, the back-scattering cross section of a dipole antenna is found approximately for normal incidence. Secondly, the two-wire transmission line is studied in detail by considering it to be two coupled dipole antennas. The capacitive end-correction for an open end is evaluated, and the radiated power and the radiation resistance are found for a resonant section of transmission line with both ends open. Finally, the dielectric-coated antenna is considered briefly. (Contractor's abstract)

750

Harvard U. Cruft Lab., Cambridge, Mass.

TRANSIENT RESPONSE OF A DIPOLE ANTENNA, by T. T. Wu. Mar. 15, 1960, 9p. incl. illus. (Technical rept. no. 319) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 237671 Unclassified

Also published in Jour. Math. Phys., v. 2: 892-894, Nov.-Dec. 1961.

The current distribution for a dipole antenna driven by a step-function voltage is found shortly after the switch-on of the voltage. The initial behavior of the transient response of a model of the dipole antenna is considered. (Contractor's abstract)

751

Harvard U. Cruft Lab., Cambridge, Mass.

SOME NON-EQUILIBRIUM PROPERTIES OF A BOSE SYSTEM OF HARD SPHERES AT EXTREMELY LOW TEMPERATURE, by T. T. Wu. Apr. 25, 1960, 69p. incl. refs. (Technical rept. no. 320) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 240488 Unclassified

Also published in Jour. Math. Phys., v. 2: 105-123, Jan.-Feb. 1961.

The pseudopotential method is used to study a special type of flow for a Bose system of hard spheres. In the first-order approximation, the wave function of the entire system is assumed to be the product of identical single-particle wave functions, which in general are time-dependent. Such a flow is necessarily irrotational, and the single-particle wave function satisfies a Schrödinger equation with a nonlinear self-coupling term. On the basis of this equation of motion, the following properties of the Bose system are discussed: the effect of the rigid wall, the moment of inertia, the compressional wave, and a type of "vortex filament." In the second-order approximation, the wave function of the system is expressed in terms of two functions such that one of them describes the

single-particle state suitable for most of the particles while the other one describes the pair excitations. The much more complicated equations of motion are found, but in this approximation the flow is no longer strictly irrotational. The compressional waves are also studied in the second-order approximation. (Contractor's abstract)

752

Harvard U. Cruft Lab., Cambridge, Mass.

EXCHANGE TERMS IN SAWADA APPROXIMATION (A PRELIMINARY DISCUSSION), by T. T. Wu. May 25, 1960, 16p. (Technical rept. no. 321) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 240641 Unclassified

The Sawada approximation for a many-fermion system is modified so that the exchange terms are treated on the same footing as the direct terms. The effects of this modification on the ground state energy per particle and on the plasma oscillations are discussed. (Contractor's abstract)

753

Harvard U. Cruft Lab., Cambridge, Mass.

THE EQUIVALENT CONDUCTANCE OF ELECTROLYTE SOLUTIONS, by W. F. Pickard. June 1, 1960, 1v. incl. illus. tables, refs. (Technical rept. no. 323) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-186632) AD 244908 Unclassified

A recently published method (see item no. 615, Vol. III) for determining the electrophoretic velocity of a spherical particle is used to reexamine the problem of the equivalent conductivity of electrolyte solutions. New formulas, from which the Ostwald dilution law and the Kohlrausch square-root law appear as special cases, are presented. These formulas are used to compute the equivalent conductivity of multi-specie electrolyte solutions: (1) for completely dissociated solutions if the dissociation constants are not known, and (2) for incompletely dissociated ones if they are known. In the special case of completely dissociated bi-specie electrolyte solutions the formulas predict the experimental results and possess the additional advantages of being computationally simpler and of containing no free parameters which may be fit to the case being examined. The theory is also used to derive new estimates for the effective radii of hydrated ions. (Contractor's abstract)

754

Harvard U. Dept. of Chemistry, Cambridge, Mass.

THE STRUCTURE OF 2,4-DIBROMOMENTHONE, by J. A. Wunderlich and W. N. Lipscomb. [1960] [7]p. incl diagrs. tables, refs. (AFOSR-1062) (In cooperation with Minnesota U., Minneapolis) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)809 and AF 49(638)485] and National Institutes of Health) AD 259746 Unclassified

Also published in Tetrahedron, v. 11: 219-225, Nov. 1960.

A 3-dimensional x-ray diffraction study has shown that the product obtained by bromination of D- or L-menthone is 2,4-dibromomenthone [2(a), 6(e)-dibromo-2(e)-isopropyl-5(e)methyl cyclohexanone]. The two Br atoms are trans, and the isopropyl and methyl groups are also trans. There are 4 molecules in the unit cell, which has dimensions a = 13.58, b = 13.81 and c = 6.25A. One intermolecular Br...Br contact of 3.52 ± 0.01A occurs, a distance which is about 0.4A shorter than the van der Waals distance. (Contractor's abstract)

755

Harvard U. Dept. of Chemistry, Cambridge, Mass.

THE STRUCTURE OF HCN TETRAMER, by B. R. Penfold and W. N. Lipscomb. [1960] [3]p. incl. diagr. (AFOSR-1063) [AF 49(638)809] AD 259747 Unclassified

Published in Tetrahedron Ltrs., no. 6: 17-19, Mar. 1960.

A detailed structure analysis of single crystals by x-ray diffraction gives conclusive proof that HCN tetramer is diaminomakonitrile in the solid state. Details of the structure analysis will be reported elsewhere.

756

Harvard U. Dept. of Chemistry, Cambridge, Mass.

STRUCTURE OF $B_{12}H_{12}^{-2}$ ION, by J. A. Wunderlich and W. N. Lipscomb. [1960] [2]p. incl. diagr. (AFOSR-1064) [AF 49(638)809] AD 259744 Unclassified

Published in Jour. Amer. Chem. Soc., v. 82: 4427-4428, Aug. 20, 1960.

An x-ray diffraction study of $K_2B_{12}H_{12}$ indicates that $(B_{12}H_{12})^{-2}$ is very nearly icosahedral in the crystal. It is shown schematically.

757

[Harvard U. Dept. of Mathematics, Cambridge, Mass.]

Final rept. Mar. 14, 1960 [8]p. (AFOSR-TR-60-46) (AF 18(600)1461) Unclassified

The activities of the investigators under the contract are briefed. A list of the publications accomplished under the contract is given.

758

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

RIEMANN'S MAPPING THEOREM FOR VARIABLE METRICS, by L. V. Ahlfors and L. Bers. [1960] [20]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research, National Science Foundation, and Office of Ordnance Research under [AF 18(600)1461]) AD 247670 Unclassified

Published in Ann. Math., v. 72: 385-404, Sept. 1960.

It is proved that if $\mu(z)$ is any bounded measurable function with $|\mu(z)| \leq k < 1$, there is a unique μ-conformal homeomorphism w^μ of the whole plane into itself for which $w^\mu(0) = 0$, $w^\mu(1) = 1$, and $w^\mu(\infty) = \infty$, and a unique μ-conformal homeomorphism W^μ of the unit disk into itself or which $w^\mu(0) = 0$ and $W^\mu(1) = 1$; a function f(z) is μ-conformal if f is continuous and has generalized derivatives locally in L_2 which satisfy $f_{\bar{z}} = \mu f_z$ almost everywhere. The principal aim here is to examine the dependence of w^μ and W^μ on μ. For example, the following results are proved: (1) if $\mu_n \to \mu$ almost everywhere ($|\mu_n(z)| < k < 1$), then $\|w^{\mu_n} - w^\mu\|$ B(R, p) $\to 0$ for each R; (2) if μ depends holomorphically on complex parameters $(\gamma_1, \ldots, \gamma_n)$ as an element of L_∞, then w^μ is a holomorphic function of these parameters, as an element of B(R, p); here B(R, p) is the Banach space of w in which $\|w\|$ (B(R, p) = $\|w\|$ L(R, p) + $\sup_{|z|, |\zeta| \leq R} |\zeta - z|^{-\lambda} |w(\zeta) - w(z)|$, $\lambda = 1 - 2/p$, $p > 2$. More detailed results are obtained as are corresponding results concerning W^μ.

759

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

THE ZEROS OF INFRAPOLYNOMIALS WITH SOME PRESCRIBED COEFFICIENTS, by O. Shisha and J. L. Walsh. July 1960 [64]p. incl. refs. (AFOSR-TN-60-541) (AF 49(638)574) AD 244391; PB 152371 Unclassified

Infrapolynomials $A(z) = a_0 + a_1 z + \ldots + a_n z^n$ on sets S, with prescribed a_n, $a_{n-1}, \ldots, a_{n-\gamma}$ and/or a_0, $a_1, \ldots, a_k$ are considered. Information on the geometric location of the zeros of such polynomials is sought. These A(z)'s are studied and determined for certain finite sets S. Cases where the prescribed coefficients are a_0, a_n and a_{n-1}, a_n, respectively, are considered. The location of the zeros with respect to discs containing S and the convex hull of S is discussed. The location of the zeros of polynomials and other rational functions, closely related in their structure to infrapolynomials with prescribed coefficients, are investigated. (Contractor's abstract)

760

Harvard U. Dept. of Mathematics, Cambridge, Mass.

NOTE ON POLYNOMIAL APPROXIMATION ON A JORDAN ARC, by J. L. Walsh. May 1960 [9]p. (AFOSR-TN-60-542) (AF 49(638)574) AD 244392 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 46: 981-983, July 1960.

The invariance of degree of polynomial and trigonometric approximation under change of independent variable have been discussed (see item no. HAR. 05: 012, Vol. II and no. 593, Vol. III). Those articles did not emphasize approximation in the complex plane on a Jordan arc rather than on a Jordan curve. Additional results concerning Jordan arcs are now indicated. Let the positive sequence (ϵ_n) satisfy certain conditions and tend to zero as $n \to \infty$, $r^n = 0(\epsilon_n)$ for any fixed r $(0 < r < 1)$, f(z) be defined on the Jordan arc E, while $f_n(z)$ $(n = 1, 2, \ldots)$ is analytic in the region $D \supset E$. If (1) $|f(z) - f_n(z)| \leq A_1 \epsilon_n$ on E, and (2) $|f_n(z)| \leq A_2 R^n$ in D for some $R > 0$, then there are polynomials $p_n(z)$ of degrees n such that (3) $|f(z) - p_n(z)| \leq A_3 \epsilon_n$ on E. The A's are independent of n and z. Now it is shown that, for bounded D, (1) and (2) are necessary conditions. Since the hypothesis is invariant under a one-one conformal mapping $w = w(z)$ of E to E_1 and, consequently, of some sub-region of D to $D_1 \supset E_1$, the classes of functions f that can be approximated by polynomials on E or E_1, respectively, with degree of approximation $0(\epsilon_n)$, are identical. Hence E_1 may be taken as the interval E_0: $-1 \leq x \leq 1$, and so by known results on trigonometric approximations f(z) is approximated on E by polynomials in z, with degree of approximation $0(n^{-k-\alpha})$ $(0 < \alpha < 1)$, if and only if $d^k f[\Phi(\cos\theta)]/d\theta^k$ satisfies a Lipschitz condition of order α, where $z = \Phi(x)$ maps E_0 on E one-to-one conformally. Finally (Theorem 3) a result is deduced concerning polynomial approximation, with degree $0(\epsilon_n)$, on an analytic Jordan arc E.

761

Harvard U. Dept. of Mathematics, Cambridge, Mass.

DEGREE OF APPROXIMATION BY BOUNDED HARMONIC FUNCTIONS, by J. L. Walsh. June 1960 [12]p. (AFOSR-TN-60-594) (AF 49(638)574) AD 244393 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 46: 1390-1393, Oct. 1960.

The results proved in the first paper (see item no. 760, Vol. III) are extended to more general degrees of approximation and to further cases of Jordan arcs. Theorem 1: Let E be an analytic Jordan curve containing z = 0 in its interior, u(z) be defined on E, D and

the $\{\epsilon_n\}$ and the A's as in the first paper, the $u_n(z)$ harmonic in D. If (1) $|u(z) - u_n(z)| = A_1\epsilon_n$ on E, and (2) $|u_n(z)| \leq A_2 R^n$ in D, then there are harmonic polynomials $p_n(z, 1/z)$ in z and $1/z$ of degrees n such that (3) $|u(z) - p_n(z, 1/z)| \leq A_3\epsilon_n$ on E. A corollary and its converse, Theorem 2 deal with the case when D contains both E and its interior. A further corollary gives a simplification of Theorem 1. Then an analytic Jordan arc E is considered. Let u_n be defined as above, $D \supset E$, and (1) and (2) be satisfied, let $z = \Phi(w)$ map E one-to-one and conformally onto E_0: $-1 \leq w \leq 1$. Then the function $u[\Phi(\cos\theta)]$ can be approximated by trigonometric polynomials in θ of degrees n, with degree of approximation $0(\epsilon_n)$. In Theorem 4, necessary and sufficient conditions in terms of approximation by trigonometric polynomials, are given for the existence of the $u_n(z)$ satisfying (1) and (2).

762

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

SOME REMARKS ON TEICHMÜLLER'S SPACE OF RIEMANN SURFACES, by L. V. Ahlfors. [1960] [21]p. (AFOSR-TN-60-721) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)574] and National Science Foundation) AD 244394 Unclassified

Also published in Ann. Math., v. 74: 171-191, July 1961.

The connection between variations of the conformal metric and quadratic differentials is considered. Attention is drawn to certain simple aspects of this connection which seem to have escaped notice. The antilinear part of the variation of the mapping function is a three times iterated integral of a quadratic differential. There is an interesting relationship with the theory of generalized Abelian integrals. The complex structure of Teichmüller space is derived from the corresponding structure of L^∞ by way of the generalized Riemann mapping theorem. This approach is also appropriate for the study of the fiber space whose fibers are the closed Riemann surfaces. (Contractor's abstract)

763

Harvard U. Dept. of Mathematics, Cambridge, Mass.

BEST APPROXIMATORS WITHIN A LINEAR FAMILY ON AN INTERVAL, by J. L. Walsh and T. S. Motzkin. July 1960 [19]p. (AFOSR-TN-60-911) (AF 49(638)574) AD 244395; AD 249011 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 46: 1225-1233, Sept. 1960.

The behavior of functions p(x) of best approximation to a given function f(x) is investigated where p(x) is supposed to belong to a linear family P and where deviation is measured on E: $0 \leq x \leq 1$ by a generalized norm $\|f(x) - p(x)\| = \int_E \tau(|f(x)-p(x)|)w(x)dx$ involving a transformer $\tau(t)$ and a weight function w(x). Properties of oscillation of f(x)-p(x) on E and identical vanishing of f(x)-p(x) on a subset of E of positive measure are considered. Sufficient conditions for best approximators are treated. Under suitable conditions, the existence of a weight function so that a given p(x) shall be a best approximation is proved. (Contractor's abstract)

764

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

SERIES EXPANSIONS OF SOLUTIONS OF THE HEAT EQUATION IN N DIMENSIONS, by D. V. Widder. Aug. 1960 [37]p. (AFOSR-TN-60-912) (AF 49(638)-574) AD 244396; PB 152376 Unclassified

This is an extension of an earlier result (see item no. 623 in Vol. III) concerning the expansion of a solution $u(x,t)$ of the heat equation, $u_{xx} = u_t$, in series of polynomial solutions. Whereas that result involved only two variables, the present one permits an arbitrary finite number of variables. It is found that the polynomial solutions of the heat equation in n dimensions are factorable into polynomials in two variables. The expansion problem may be considered as an investigation of the space spanned by linear combinations of these factorable solutions. (Contractor's abstract)

765

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

ON THE CIRCLES OF CURVATURE OF THE CURVES OF STEEPEST DESCENT OF GREEN'S FUNCTION, by J. L. Walsh. Oct. 1960 [17]p. (AFOSR-TN-60-1138) (AF 49(638)574) AD 244397; PB 152369 Unclassified

Elementary geometric properties of the curves of steepest descent, namely the lines of force, or orthogonal trajectories of the level loci of Green's function are considered. The method uses an integral representation of Green's function essentially due to Hilbert. (Contractor's abstract)

766

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

ON THE DEGREE OF CONVERGENCE OF SEQUENCES OF EXTREMAL POLYNOMIALS AND OTHER EXTREMAL FUNCTIONS, by J. L. Walsh and A. Sinclair. Mar. 1960 [48]p. incl. refs. (AFOSR-TN-60-223) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)845 and Office of Naval Research under N5ori-07634) AD 244390; PB 152370 Unclassified

Let a given function F(z) be of class L^p, $p > 1$, on an analytic Jordan curve γ in the plane of the complex variable z, and let $p_n(z)$ be the unique sequence of polynomials in z of respective degrees n of best approximation to F(z) on γ in the sense of minimizing $\int_\gamma |F(z) - p_n(z)|^p |dz|$. These minimizing $p_n(z)$ may also be subjected to certain auxiliary conditions of interpolation $p_n(w_k) = u_k$, $k = 1, 2, \ldots, m$, which are independent of n and are not necessarily related to F(z). Convergence and degree of convergence of the sequence $p_n(z)$ to a possible limit minimizing function, and various properties of this limit function are studied. (Contractor's abstract)

767

Harvard U. Graduate School of Business Administration, Cambridge, Mass.

THE EFFECTS OF AUDIENCES ON COMMUNICATORS, by R. A. Bauer, I. de Sola Pool and others. Final rept. Sept. 1960, 141p. incl. diagrs. tables. (AFOSR-TR-60-129) (In cooperation with MIT Center for International Studies, Cambridge) (AF 49(638)486) AD 246881 Unclassified

The feedback stage of communication is explored, specifically the effect of anticipated and actual audience reaction on the communicator's behavior, attitudes, and on what he remembers of information to which he is exposed. The five sections of the report deal primarily with various problems and ideas suggested by, or related to, audience effect findings of a previous experiment. (Contractor's abstract)

768

[Harvard U. Graduate School of Business Administration, Cambridge, Mass.]

NEWSMEN'S FANTASIES, AUDIENCES, AND NEWSWRITING, by I. de Sola Pool and I. Shulman. [1959] [14]p. incl. tables. (In cooperation with MIT Center for International Studies, Cambridge) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)486, Ford Foundation, and Foundation i Research on Human Behavior) Unclassified

Published in Public Opinion Quart., v. 23: 145-158, Summer 1959.

Just as most actors and actresses need a live and responsive audience, it appears that newsmen have more than a trivial relationship to the audiences for which they are writing. A direct and empirical study of the influence of the readers on the newswriter is reported. (Contractor's abstract)

769

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

SOUND PROPAGATION IN A DILUTE FERMI GAS AT ZERO TEMPERATURE, by K. Gottfried and L. Pičman. [1960] [51]p. incl. diagrs. refs. (AFOSR-TN-60-395) (AF 49(638)589) AD 251754 Unclassified

Also published in Proc. Roy. Danish Acad., v. 32: 1-30, 1960.

The attenuation of zeroth sound in a dilute Fermi gas with repulsive interactions is studied. The problem is formulated in terms of the Green function G which describes the propagation of density fluctuations through the system. The simplest approximation to G leads to Landau's dispersion law, which is analyzed in some detail. The contribution of the phonons' zero point oscillations to the ground state energy is estimated, and shown to lead to a term which has an essential singularity at the origin of the coupling constant plane. The energy and width of the phonon is given by the poles in the spectral representation of G, and the location of these poles is determined from the the Fredholm solution of an approximate integral equation satisfied by G. In this way it is shown that the width, divided by the displacement of the collective state above the single particle continuum of the free gas, vanishes linearly in the long wave length limit. It is also shown that in the limit of extreme dilution the correct damping can be obtained by merely taking the finite lifetime of single-particle excitations into account, and ignoring the dissipative effects of the non-instantaneous interactions between the particles in the medium. Finally, it is also argued that the Fredholm method is the natural tool for discussing many problems in the theory of collective motion. (Contractor's abstract)

770

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

UNITARY TRANSFORMATIONS AND THE ACTION PRINCIPLE, by J. Schwinger. [1960] [15]p. (AFOSR-TN-60-918) (AF 49(638)589) AD 243572 Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 46: 883-897, June 1960.

In the first 3 papers of this series (see item nos. 774, 780, 786), the author developed from first principles the mathematical structure of quantum statistics; in this 4th paper he builds upon this foundation the quantum dynamics of systems whose basic dynamic variables have continuous spectra. The first half consists of an introduction to the theory of continuous groups of unitary transformation. Next the theory is applied to the special canonical group, a 3-parameter group whose infinitesimal generators are a pair of complementary dynamic variables q, p (which generate displacements in -p, q), together with the unit operator. The dynamics of a system with n continuous degrees

of freedom q_k, p_k k = 1, . . . , n (denoted collectively by x) is now characterized by a one-parameter group of transformations generated by some Hermitian function $G(x, \tau)$ of the dynamic variables and a time parameter τ. Since these transformations induce an evolution $x(\tau)$ of the basic variables, in order to characterize completely the transformation function between times τ_1 and τ_2 one has to combine them with transformations of the special canonical group at each time. In this way one arrives at the quantum action principle which the author enunciated in 1953 [Phys. Rev., v. 91: 713-728, 1953], the function G being identified as the Hamiltonian of the system.

771

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

THE SPECIAL CANONICAL GROUP, by J. Schwinger. [1960] [15]p. (AFOSR-TN-60-1200) [AF 49(638)589] AD 246539 Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 46: 1401-1415, Oct. 1960.

This note is concerned with the further development and application of an operator group described in a previous paper (see item no. 770). A system described by a single pair of canonical variables q, p is considered. It is obtained as a limit of a system possessing a state space of finite dimension. In the finite-dimensional case, a convenient basis for all observables is the discrete analogue of exp i(pq' - p'q) where q' and p' are real numbers. The author considers superpositions of these operators of the infinite-dimensional case which can be obtained as limits from the analogous finite-dimensional case, and gets an operational calculus for such superpositions. The calculus is used to construct finite canonical transformations from infinitesimal ones. A variety of examples are given. Connections are established with the methods of functional integration (the special canonical group referred to in the title is the group extension of the translation group of q and p so defined the q → exp iqa and p → exp ipb define a group representation of the extended group).

772

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

BROWNIAN MOTION OF A QUANTUM OSCILLATOR, by J. Schwinger. [1960] [26]p. (AFOSR-26) [AF 49-(638)589] AD 456501 Unclassified

Published in Jour. Math. Phys., v. 2: 407-432, May-June 1961.

An action principle technique for the direct computation of expectation values is described and illustrated in detail by a special physical example, the effect on an oscillator of another physical system. This simple problem has the advantage of combining immediate physical applicability (e.g., resistive damping or maser amplification of a single electromagnetic cavity mode) with a significant idealization of the complex problems encountered in many-particle and relativistic field theory. Successive sections contain discussions of the oscillator subjected to external forces, the oscillator loosely coupled to the external system, an improved treatment of this problem and, finally, there is a brief account of a general formulation. (Contractor's abstract)

773

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

COLLISION CROSS-SECTIONS OF THE DEUTERON AT HIGH ENERGIES, by R. J. Glauber. [1960] [8]p. (AFOSR-831) (AF 49(638)589) AD 258559 Unclassified

Also published in Nuclear Forces and the Few-Nucleon Problem; Proc. Internat'l. Conf., University Coll., London (Gt. Brit.). (July 8-11, 1959), New York, Pergamon Press, v. 1: 233-240, 1960.

A number of effects which lead to a difference between the high energy cross-sections of the deuteron and the sum of the corresponding cross-sections of a free neutron and proton are considered in detail. Particular attention is paid to the role of double scattering, which is chiefly responsible for explaining the cross-section difference at energies below the meson production threshold. A simple analysis is given of the error made by the impulse approximation in neglecting the effects of double scattering. (Contractor's abstract)

774

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

THE ALGEBRA OF MICROSCOPIC MEASUREMENT, by J. Schwinger. [1959] [12]p. (AFOSR-3379) [AF 49(638)589] Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 45: 1542-1553, Oct. 1959.

An outline is given of a foundation of the quantum mechanical theory of measurement, starting from physical statements about the nature of the process of measurement. By confining to the simple case in which observables can take a finite number of different values, all technical mathematical difficulties can be avoided. The analysis goes beyond the well-known analysis of von Neumann in treating measurements, M(a',b'), in which given systems are rejected if they do not have the value, b', of an observable b and if accepted are transformed into systems which have the value a' of the observable a. (In the quantum mechanical formalism M(a',b') is the matrix $\psi_{a'} \otimes \psi_{b''}$ where $\psi_{a'}$ for $\psi_{b'}$.) It is assumed that M(a',b')M(c',d') = $< b' | c' >$ M(a',d') where $< b' | c' >$ is a complex number. Given this equation and $< b' | c' > = < c' | b' >$, an elegant and simple deduction of the ordinary formalism of quantum mechanics is given.

775

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

COLLISIONS OF PARTICLES WITH NUCLEI AT EXTREMELY HIGH ENERGIES (Abstract), by R. J. Glauber. [1960] [1]p. [AF 49(638)589] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 30, Jan. 27, 1960.

If the incident particle has sufficiently high energy, an approximate solution of the general problem of multiple scattering may easily be effected in closed form. The optical potential which furnishes an equivalent description of the elastic scattering by a nucleus may be exhibited explicitly. It is conveniently discussed in terms of a pseudopotential which we may define to act between the incident particle and a target nucleon. The pseudopotential, apart from a constant factor, is the Fourier transform of the amplitude for elastic scattering by a single nucleon (with the momentum transfer as integration variable). It is in general complex and spin-dependent, and exists at arbitrarily high energies, whatever the underlying interaction. The optical potential for the nucleus, assuming the nucleons uncorrelated, is simply the average of the pseudopotential over the nuclear density distribution. The real and imaginary parts of the optical potential therefore, in general, differ slightly in shape. Since the range of the imaginary part of the pseudopotential is roughly half that of the real part, the imaginary part of the optical potential is a little more sharply defined than the real part.

776

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

GROUND-STATE PROPERTIES OF NUCLEAR MATTER (Abstract), by R. D. Puff and P. C. Martin. [1960] [1]p. [AF 49(638)589] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 30, Jan. 27, 1960.

The properties of nuclear matter in its ground state are studied by using Green's functions which take into account the bound nature of this state. An approximation is introduced to eliminate correlations of a single particle with a pair of particles when that pair is highly correlated. The approximation yields a set of equations for the energy, density, and energy-momentum distribution of the bound system. These equations define a single particle energy-momentum relation for the bound particles. On the other hand, the momentum distribution $\rho(k)$ differs from that of the noninteracting Fermi gas, since momenta larger than $k_f^p = (3/2\,\pi^2\rho)^{1/3}$ contribute significantly. The approximation exhibits a cut-off momentum about 10% larger than k_f^p. The calculated energy per particle is -14.9 mev, while the density is $(4/3\,\pi\gamma_o^3)^{-1} = \gamma_o = 0.92 \times 10^{-13}$ cm. In the approximation, the condition that the pressure vanish at equilibrium requires that the energy of the highest filled state, equal the average energy per particle. The single particle energy associated with the momentum k_f^p, which has no significance in our calculation since it is not the highest filled momentum state, is the same as the energy ($\sim$-28 mev) obtained by Brueckner for k_f^p. This coincidence suggests a qualitative explanation of the discrepancy between the highest single particle energy and the average energy per particle in his calculation.

777

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

NUCLEAR CORRELATION FUNCTIONS FROM INELASTIC SCATTERING (Abstract), by W. Czyz and K. Gottfried. [1960] [1]p. [AF 49(638)589] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 30, Jan. 27, 1960.

It is well known that the cross section for scattering a weakly interacting probe (e.g. an electron) through momentum transfer q is related to the target's pair correlation functions. A discussion is given of an experimental wherein not only q, but also the electron's energy loss ω is determined. The relevant cross section $\sigma(q, \omega)$ is then related to the time-dependent correlation function. If the target is a free Fermi gas, and q is held fixed, then $\sigma(q, \omega) = 0$ for ω is greater than some critical value $\omega_c(q)$. It is shown that with only minor qualifications the property also obtains for finite targets such as heavy nuclei. If there are interactions between the target's constituents, then $\sigma(q, \omega) \neq 0$ for $\omega > \omega_c$: for such values of ω the scattering is due entirely to correlations. Calculations of $\sigma(q, \omega)$ in the domain of interest will be reported for simple models (e.g., the hard sphere gas), and the feasibility of gaining useful information about correlations in this fashion will be discussed.

778

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

ON THE STRUCTURE OF PERTURBATION-THEORETIC INTEGRALS (Abstract), by C. M. Sommerfield. [1960] [1]p. [AF 49(638)589] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 66, Jan. 27, 1960.

A method of carrying out the quadratures involved in perturbation integrals of field theory which contain an integration over a single virtual four-momentum is developed. The inherent mathematical symmetries of the expressions are maintained explicitly at each stage. It is shown that an integral characteristic of a process involving n incoming or outgoing particles may be expressed as the sum of n terms, each of which is in the form of a 1-dimensional integration of an expression involving only n-1 incoming or outgoing particles. By continuing in this manner an integral representation for the original expression which is in the form of a sum of n! n-fold iterated integrals is obtained. This representation has the advantage that the singularities are explicitly evident in regard to both location and type.

779

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

ON ANALYTICITY OF VACUUM EXPECTATION VALUES OF n-FOLD PRODUCTS AND FULLY RETARDED COMMUTATORS (Abstract), by D. [J.] Kleitman. [1960] [1]p. [AF 49(638)589]
Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 82, Jan. 27, 1960.

The procedure described by Källén and Wightman for determining the regions of analyticity of vacuum-expectation values of products of n-local scalar fields, and of retarded commutators of such fields, involves 3 steps. These are: determination of the boundaries of the extended tubes in terms of scalar products of the vector arguments; extension of analyticity from the extended tubes to the union of permuted extended tubes; and the computation of the holomorphy envelope of that union. However, the second step listed in the foregoing is only clearly justified if every point in the intersection of each pair of permuted extended tubes is connected to a real point by a continuous path lying entirely in that intersection. It is shown that this condition is satisfied by the various intersections of permuted extended tubes for 3 point functions. As a consequence, the procedure actually employed by Källén and Wightman is seen to be justified. Extension of that procedure to treat 4 and 5 point functions requires that the analogous condition be satisfied by the intersections of permuted extended tubes corresponding to such functions. The question of whether or not such conditions are indeed satisfied will be discussed.

780

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

THE GEOMETRY OF QUANTUM STATES, by J. Schwinger. [1960] [9]p. [AF 49(638)589]
Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 46: 257-265, Feb. 1960.

This is the second of a series of papers in which the author builds from the basic laws of microscopic measurement the general structure first of quantum statistics and then of quantum dynamics. The first (see item no. 774) describes the algebra of "measurement symbols" such as M(b,a), which denotes a process whereby a system is accepted only from a state in which a property A has the value a and emerges in a state in which B has the value b. Symbols representing states are introduced by remarking that, since the process denoted by M(b,a) is "physically" inseparable into successive stages, one is free to perform the "formal" factorization $M(b,a) = M(b,o)M(o,a)$, where o denotes a fictitious null state. The $\Psi(b) = {}_{def}M(b,o)$ and $\Phi(a) = {}_{def}M(o,a)$, as consequence of the null property of o, belong to two mutually adjoint vector algebras associated with the states of the system, the geometry of states is a unitary geometry. The elements of the measurement algebra receive a geometrical interpretation as linear operators, which themselves for a vector space of dimensionality equal to the square of that of the state space.

781

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

EUCLIDEAN GAUGE TRANSFORMATION, by J. Schwinger. [1960] [2]p. [AF 49(638)589]
Unclassified

Published in Phys. Rev., v. 117: 1407-1408, Mar. 1, 1960.

The Green's function gauge transformation induced by the elimination of the longitudinal field in Euclidean electrodynamics is discussed.

782

Harvard U. [Lyman Lab, of Physics] Cambridge, Mass.

DIFFERENCES IN SHAPE OF REAL AND IMAGINARY OPTICAL MODEL POTENTIALS (Abstract), by R. F. Verdier, A. E. Everett, and R. J. Glauber. [1960] [1]p. [AF 49(638)589]
Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 244, Apr. 25, 1960.

The effect of variation of the potential parameters on the cross section and polarization predicted by the optical model of nucleon-nucleus scattering is being investigated, using a program written for the IBM 704 computer. The program is quite general, in that it allows the strengths, ranges and surface thicknesses of the real and imaginary parts of the central and spin-orbit potentials to be chosen independently. The potentials and charge distribution are taken to have

Woods-Saxon shapes, but the program is constructed to accomodate arbitrary shapes. The radial Schroedinger equation for each partial wave is integrated numerically. Differences in the shapes of the real and imaginary potentials have been predicted theoretically. Preliminary calculations carried out for neutrons of 160 mev have shown that even a 10% difference in the surface thicknesses of the real and imaginary central potentials produces a marked filling-in of the diffraction minima of the differential cross section, and hence may result in an improved fit to the experimental data, a difference between the 2 radii produces an even greater effect. Further results will be discussed.

783

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

INTERACTION OF CHARGED PARTICLES WITH A QUANTIZED FIELD (Abstract), by L. P. Kadanoff and R. J. Glauber. [1960] [1]p. [AF 49(638)589] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 256, Apr. 25, 1960.

The interaction between nonrelativistic electron and the electric field within a cavity that has but a single mode of oscillation has been considered as a problem in quantum electrodynamics. If the energy of the incident electron is sufficiently high, an approximate S matrix can be found by using the high-energy approximation. The energy spectra of electrons emerging from the cavity are discussed for experiments in which no measurements are made on the final state of the cavity. The quantum mechanical measurement process can be illustrated by discussing the spectra for certain limiting forms of the initial cavity states and electron wave packets. The spectra, their mean values, and central moments are stated explicitly. For the particular case in which the initial electron energy is precisely defined, we show explicitly how the line spectrum becomes related to the classical continuum as the average number of quanta exchanged with the cavity increases. The classical continuum results from the smoothing of a line spectrum in which the intensities vary quite irregularly. The line intensities decay exponentially in the classically forbidden regions of energy transfer.

784

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

HIGH-ENERGY SCATTERING BY COMPOUND SYSTEMS (Abstract), by D. J. Kleitman and R. J. Glauber. [1960] [1]p. [AF 49(638)589] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 269, Apr. 25, 1960.

At sufficiently high energy, the small-angle scattering of a particle by a potential that can be decomposed into two parts may be described completely by an expression which involves only the amplitudes for single scatterings by the individual parts and double scattering by both of them. The double-scattering term requires a knowledge only of the scattering amplitudes on the energy shell. The appearance of this result is surprisingly simple when compared with the formal multiple-scattering expansion, since it holds for systems for which triple scattering is nonnegligible and for which off-energy-shell propagation in intermediate states must be taken into account. Examples of such systems are given. The simplifications are due to cancellations which take place in the high-energy limit. This result shows that the only multiple-scattering corrections to the impulse approximation for small-angle deuteron cross sections at high energies will be due to double scattering with energy conserved in the intermediate state. It suggests that these may be the leading corrections at lower energies.

785

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

TIME-DEPENDENT STATISTICS OF AN ISING CHAIN, (Abstract), by R. J. Glauber. [1960] [1]p. [AF 49-(638)589] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 296, Apr. 25, 1960.

The state of a closed N-site Ising chain is described by a set of 2-valued spin variables, $\sigma_j = \pm 1$, $(j = 1 \cdots N)$. It is assumed that the spins, in the absence of coupling between them, interact independently with an external agency (e.g., a heat reservoir) which causes the σ_j to vary as random functions of time. All of the spins, when uncoupled, are assumed to have the same probability per unit time for undergoing transitions to the unoccupied state. Coupling between the spins is introduced by assuming that the probability per unit time that any spin flips is influenced by the spin states of its neighbors relative to its own. The set of 2^N probability functions for the various states of the system obeys a set of (coupled) differential equations characteristic of a continuous Markoff process. The expectation values of the spins $\langle\sigma_j(t)\rangle$ and of their bilinear products $\langle\sigma_i(t)\sigma_j(t)\rangle$ satisfy reduced systems of equations which may be solved explicitly for the case of nearest-neighbor coupling. The solutions relax at large times into those of the familiar Ising model at equilibrium. Also secured is an evaluation of the time-dependent correlation function $\langle\sigma_i(t)\,\sigma_j(t')\rangle$ for an arbitrary pair of spins.

786

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

UNITARY OPERATOR BASES, by J. Schwinger. [1960] [10]p. [AF 49(638)589] Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 46: 570-579, Apr. 1960.

Continuing the program described earlier (see item no. 780), the generation of a complete orthonormal operator basis from a "complementary" pair of unitary operators is discussed. If in a state geometry of dimensionality N one defines U, V to be cyclic permutation operators such that $\langle a^k| V = \langle a^{k+1}|$, $\langle b^k| U^{-1} = \langle b^{k+1}|$, modulo N, where $\langle a^k|$, $\langle b^k|$ (k = 1,...,N) are two complete orthonormal bases in state space, the eigenvectors of U, V respectively, then the set $X(m,n) = {}_{def} N^{-1/2} U^m V^n$ (m, n = 0,...,N-1) is a complete orthonormal operator basis. For general N the pair U, V (of period N) may be factorized into f mutually commutative pairs U_j, V_j of period ν_j, corresponding to the decomposition of N into prime factors ν_j = (j=1,...,f). The different possible types of quantum degrees of freedom may now be classified according to the characteristics of the algebras generated by the pairs $U(\nu)$, $V(\nu)$ belonging to different primes ν. The limiting case $\nu \to \infty$ is best discussed in terms of the Hermitian operators, q, p of which U, V are functions; in this way one obtains the familiar complementary pair of properties with continuous spectra.

787

Harvard U. [Mallinckrodt Chemical Lab.] Cambridge, Mass.

SYNTHESIS AND CLEAVAGE OF PERFLUOROVINYLTIN COMPOUNDS, by H. D. Kaesz, S. L. Stafford, and F. G. A. Stone. Apr. 1960, 12p. incl. diagrs. tables, refs. (AFOSR-TN-60-273) (Also bound with its AFOSR-TN-60-274; AD 235852) (AF 49(638)518) AD 235852 Unclassified

Presented at 137th meeting of Amer. Chem. Soc., Cleveland, Ohio, 1960.

Also published in Jour. Amer. Chem. Soc., v. 82: 6232-6235, Dec. 20, 1960.

Perfluorovinyltin compounds were prepared according to the following reaction: $Me_2SnCl_2 + 2CF_2 = CFBr$ $\xrightarrow{Mg/(CH_2)_4O}$ $Me_2Sn(CF{:}CF_2)_2 + MgBr_2 + MgCl_2$.

Results of a study on the cleavage of perfluorovinyltin compounds with hydrogen chloride indicate the following sequence of cleavage: $CF_2{:}CF \simeq C_6H_5 > CH_2{:}CH >$ alkyl $> C_2F_5$.

788

Harvard U. [Mallinckrodt Chemical Lab.] Cambridge, Mass.

PREPARATION AND STUDY OF SOME PERFLUOROALKYL COMPOUNDS OF TIN AND LEAD, by H. D. Kaesz, J. R. Phillips, and F. G. A. Stone. Apr. 1960, 17p. incl. tables, refs. (AFOSR-TN-60-274) (Also bound with its AFOSR-TN-60-273; AD 235852) (AF 49(638)518) AD 235852; PB 146765 Unclassified

Presented at 137th meeting of the Amer. Chem. Soc., Cleveland, Ohio, 1960.

Also published in Jour. Amer. Chem. Soc., v. 82: 6228-6232, Dec. 20, 1960.

Tetraalkyllead compounds react directly with perfluoroalkyl iodides, under the influence of ultraviolet light or on heating, to give compounds of the type $R_3PbC_nF_{2n+1}$. When similar reactions were carried out with tetraalkyltin compounds most of the perfluoroalkyl groups went to produce fluorocarbons, and only small amounts of the $R_3SnC_nF_{2n+1}$ compounds were detected. However, the tin-tin bond in hexaorganoditin compounds is readily cleaved by perfluoroalkyl iodides to give the desired $R_3SnC_nF_{2n+1}$ derivates. The perfluoroalkyl group is quantitatively removed by base from the perfluoroalkyltin and -lead compounds, but treatment with electrophilic reagents lead to preferential cleavage of alkyl or aryl groups. Important features of the infrared spectra of the new compounds are described. (Contractor's abstract)

789

Harvard U. Mallinckrodt Chemical Lab., Cambridge, Mass.

DIALKYLBIS(PENTAFLOROETHYL)TIN COMPOUNDS, by P. M. Treischel and F. G. [A.] Stone. June 1960, 3p. (AFOSR-TN-60-473) (Also bound with its AFOSR-TN-60-552; AD 242310) (AF 49(638)518) AD 242310 Unclassified

Also published in Chem. and Indus. (London), No. 26: 837-838, June 25, 1960.

Dialkyl-bis(pentafluoroethyl) tin compounds were formed by adding pentafluoro-iodoethane to a mixture of dimethyltin dichloride and magnesium in tetrahydrofuran. The infrared spectrum of the new compound, dimethyl-bis(pentafluoroethyl) tin, shows very strong bands at 1315, 1195, 1098 and 1063 cm^{-1} in the C-F region, and a strong band at 928 cm^{-1} owing to the C-C stretch. The new compounds, $(n\text{-}C_4H_9)_2Sn(C_2F_5)_2$ and $(n\text{-}C_4H_9)_3Sn(C_2F_5)_2$ were also prepared in the above manner and showed boiling points of 42°/1 mm and 48°/0.035 mm, respectively. Dialkyl-bis(pentafluoroethyl)tin compounds release pentafluoroethane quantitatively on warming with aqueous base, however towards acids they are relatively inert.

790

Harvard U. [Mallinckrodt Chemical Lab.] Cambridge, Mass.

ORGANOBORON HALIDES. V. PERFLUOROVINYLBORON COMPOUNDS, by S. L. Stafford and F. G. A. Stone. June 1960, 9p. incl. diagrs. tables. (AFOSR-TN-60-552) (Bound with its AFOSR-TN-60-478; AD 242310) (AF 49(638)518) AD 242310; PB 150839 Unclassified

Presented at 137th meeting of the Amer. Chem. Soc., Cleveland, Ohio, Apr. 1960.

Also published in Jour. Amer. Chem. Soc., v. 82: 6238-6240, Dec. 20, 1960.

A means for preparing the perfluorivinylboron compounds, CF_2:$CFBF_2$, CF_2:$CFBCl_2$, $(CF_2$:$CF)_2BCl$, and $(CF_2$:$CF)_3B$ was suggested by the recently demonstrated cleavage of perfluorovinyltin compounds by protonic acids and by the use of vinyltin compounds to prepare vinylboron halides. These compounds are the first reported examples of covalent boron compounds in which the organo-group is fully fluorinated.

791

Harvard U. Mallinckrodt Chemical Lab., Cambridge, Mass.

SPECTROSCOPIC STUDIES ON ORGANOMETALLIC COMPOUNDS. III. INFRA-RED SPECTRA OF PERFLUOROVINYL METAL COMPOUNDS, by S. L. Stafford and F. G. A. Stone. Jan. 1960 [19]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1485) (Bound with its AFOSR-TN-60-1486; AD 250104) (AF 49(638)-518) AD 250104 Unclassified

Also published in Spectrochim. Acta, v. 17: 412-423, Apr. 1961.

The infrared spectra of the compounds CF_2:$CFBF_2$, CF_2:$CFBCl_2$, $(CH_3)_2Sn(CF$:$CF_2)_2$, $(CH_3)_2Ge(CF$:$CF_2)_2$, $(C_2H_5)_2Si(CF$:$CF_2)_2$, $(CF_2$:$CF)_4Sn$, $(CF_2$:$CF)_3As$, and $(CF_2$:$CF)_2Hg$ were recorded in the region 650-3500 cm^{-1}. Most of the observed absorption frequencies have been assigned by correlation with known spectra. (Contractor's abstract)

792

Harvard U. Mallinckrodt Chemical Lab., Cambridge, Mass.

CHEMISTRY OF THE METAL CARBONYLS. VIII. PERFLUOROACYL AND PERFLUOROALKYL DERIVATIVES OF MANGANESE AND RHENIUM, by H. D. Kaesz, R. B. King, and F. G. A. Stone. Jan. 1960, 6p. incl. table, refs. (AFOSR-TN-60-1488) (Bound with its AFOSR-TN-60-1485; AD 250104) (AF 49(638)-518) AD 250104 Unclassified

Also published in Zeitschr. Naturforsch., v. 15b: 763-764, Dec. 1960.

Perfluoroalkyl-manganese- and perfluoroalkylrhenium-pentacarbonyl compounds were synthesized by the decarbonylation of the perfluoroacyl derivative $C_nF_{2n+1}COMe(CO)_5$ (where Me = Mn, Re).

793

Harvard U. Medical School. Dept. of Pharmacology, Boston, Mass.

RECEPTIVE FIELDS OF OPTIC NERVE FIBRES IN THE SPIDER MONKEY, by D. H. Hubel and T. N. Wiesel. [1960] [9]p. incl. diagrs. refs. (AFOSR-1389) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)713 and Public Health Service) Unclassified

Published in Jour. Physiol., v. 154: 572-580, Dec. 1960.

The methods used to observe the ganglion cell responses to monochromatic stimuli are described. The results are: (1) All fields mapped with white light had a concentric arrangement similar to that of cat retinal ganglion cells, with a sharply demarcated 'on' center surrounded by an antagonistic 'off' periphery, or the reverse. (2) The smallest receptive field centers were found near the fovea, and the size of centers tended to increase with increasing distance from the fovea. The smallest center had a diam of 4 min of arc (corresponding to about 20 μ on the retina) and was located 4° from the fovea; the largest center had a diam of 2°. (3) Three ganglion cells out of about 100 responded in a specific way to colored stimuli. In these cells light of short wave-length produced an 'on' response and light of long wave-length evoked inhibition followed by an 'off' response. Very weak responses were obtained to white light, presumably owing to the antagonism between light of short and long wave-lengths.

794

Harvard U. School of Dental Medicine, Boston, Mass.

HYPOTHALAMIC SECRETORY FACTOR FOR ADRENOCORTICOTROPIC HORMONE (SF-ACTH), by P. L. Munson. Annual rept. Sept. 23, 1960, 6p. incl. tables. (AFOSR-TN-60-1128) (AF 49(638)740) AD 243573 Unclassified

Research was conducted (1) to perfect a biological assay system for the postulated neural hormone thought to be the mediator between stress stimuli and increased secretion of ACTH; and (2) the purification of this hormone from extracts of hypothalamus. The evidence for and against the existence of such a hypothalamic hormone was discussed. The biological assay system

to be used in the research was described and illustrated. The principal bases for the bioassay method are the inhibitory effect of morphine against the effect of nonspecific stressful substances in the rat, and the assumption that the action of the hormone is not inhibited by morphine. The preparation of a crude active extract of calf hypothalamus was described. It consists of extraction of the fresh tissue with 0.1N hydrochloric acid, lyophilization of the centrifuged supernate, and extraction of the resulting powder with distilled water. This crude extract was active in stimulating ACTH secretion in rats, and its effect was not inhibited by morphine. Only a small part of the effect was due to ACTH-like material in the extract. A 9-fold purification of the crude extract was obtained by removing inactive constituents by precipitation at pH 4.7. The pH 4.7 supernate could be dialyzed in 24/32 in. tubing without apparent loss of activity. Part of the activity passed through 20/32 in. tubing, but an attempt to purify the extract further by differential dialysis was not encouraging. (Contractor's abstract)

795

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

SOME APPLICATIONS OF EXPANSION CONSTANTS, by B. Grünbaum. [1960] [9]p. incl. refs. (AF 61-(052)04) Unclassified

Published in Pacific Jour. Math., v. 10: 193-201, 1960.

Let X be a metric space. For $x \in X$ and $p \geq 0$, let $S(x;p)$ denote the cell $[y \in X : d(x,y) \leq p]$. The expansion constant $E(X)$ of X is the infimum of numbers μ with the property that $\bigcap_{\alpha \in A} S(x_\alpha;\mu\rho_\alpha) \neq 0$ for any family $S(x_\alpha;\rho_\alpha)$, $\alpha \in A$, of pairwise intersecting cells in X. For a retraction f of a metric space Y onto a subspace X, the norm $\|f\|$ of f is the infimum of numbers μ such that $d(f(y),f(y')) \leq \mu d(y,y')$ for all $y,y' \in Y$. The retraction constant $r(X)$ of a metric space X is the infimum of numbers μ with the following property: for every metric space Y which contains X and only one point not in X, there is a retraction f of Y onto X with $\|f\| \leq \mu$. For a normed linear space X, the projection constant $p(X)$ of X is the infimum of numbers μ with the following property: for any normed linear space Y containing X as a subspace of deficiency 1, there is a projection P of Y onto X with $\|P\| \leq \mu$. If the constant $E(X)$ (or $r(X)$ or $p(X)$) defined as an infimum is actually a minimum, then it is said to be exact. The following results are proved. (I) For any normed linear space X, we have $E(X) = p(X)$. If one of them is exact, so is the other. (II) $E(X) \leq r(X)$ holds for any metric space X.

796

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

LOCAL DIFFERENTIAL ALGEBRA, by A. Robinson. May 1959, 61p. (Technical scientific note no. 4) (AFOSR-TN-59-817) (AF 61(052)187) AD 220589; PB 145321 Unclassified

Also published in Trans. Amer. Math. Soc., v. 97: 427-456, Dec. 1960.

For abstract see item no. 640, Vol. III.

797

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

THE ANGULAR DISTRIBUTION OF EIGENVALUES OF NON-SELF-ADJOINT ELLIPTICAL BOUNDARY VALUE PROBLEMS OF HIGHER ORDER, by S. Agmon. June 1960, 18p. (Technical scientific note no. 8) (AFOSR-TN-60-1179) (AF 61(052)187) AD 244382 Unclassified

Results on the angular distribution of eigenvalues for non-self-adjoint elliptic boundary value problems of arbitrary order are described. Characterizing a general class of elliptic boundary value problems whose spectrum consists of a discrete set of eigenvalues, a subclass of non-self-adjoint boundary value problem whose eigenvalues cluster along a single ray in the complex plane is described. The oblique derivative problem belongs to this class. Some other elliptic boundary value problems with eigenvalues clustering along a finite number of rays are also described. All these results are connected with growth properties of the resolvent operator along certain rays in the complex plane, and follow from a single theorem dealing with directions of regular growth of the resolvent. (Contractor's abstract)

798

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

LOCAL DIFFERENTIAL ALGEBRA. THE ANALYTIC CASE, by S. Halfin and A. Robinson. June 1960, 9p. (Technical scientific note no. 9) (AFOSR-TN-60-1180) (AF 61(052)187) AD 244383 Unclassified

A test is obtained for the existence of an analytic solution for a system of algebraic differential equations with initial condition of a general character. (Contractor's abstract)

799

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

THE PRODUCT OF SUMMABILITY METHODS. III. NEW CLASSES OF TRANSFORMATION AND THEIR PROPERTIES, by A. Jakimovski. Aug. 1960, 34p. (Technical scientific note no. 10) (AFOSR-TN-60-1181) (AF 61(052)187) AD 244384 Unclassified

A new class of linear transformations is defined and investigated. Necessary and sufficient conditions for the regularity of another class of linear transformations are given and Tauberian theorems for still another class of linear transformations are proved. (Contractor's abstract)

800

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

SOME RESULTS ON CONVEX BODIES AND BANACH SPACES, by A. Dvoretzky. Aug. 1960, 63p. incl. refs. (Technical scientific note no. 11) (AFOSR-TN-60-1182) (AF 61(052)187) AD 244335 Unclassified

The following theorem is proved: If C is a convex body (compact set with non-void interior) symmetric about the origin in a Euclidean space of sufficiently high dimension, then there exists a k-dimensional subspace whose intersection with C is nearly spherical. Applications to Banach spaces are also given. (Contractor's abstract)

801

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

LOCAL PARTIAL DIFFERENTIAL ALGEBRA, by S. Halfin and A. Robinson. Oct. 1960, 21p. (Technical scientific note no. 12) (AFOSR-TN-60-1407) (AF 61-(052)187) AD 246977 Unclassified

The algebraic theory for the solution of initial value problems for systems of algebraic differential equations is extended to systems of partial differential equations. A homomorphism into a partial differential ring with n-1 differentiations is defined, which corresponds to the surface on which the initial values are given. (Contractor's abstract)

802

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

A SUBSPACE OF l^1 WHICH IS NOT ISOMORPHIC TO l^1, by J. Lindenstrauss. Dec. 1960, 12p. incl. refs. (Technical scientific note no. 14) (AFOSR-800) (AF 61(052)187) AD 258236 Unclassified

A Banach space B is said to be of minimal linear dimension if every closed subspace of B has itself a closed subspace which is isomorphic to B. Banach has already proved that the spaces c_0 and $l^p (1 \leq p < \infty)$ are of minimal linear dimension. Thus the question arises: Do there exist infinite dimensional closed subspaces of c_0 or of l^p $(1 \leq p < \infty)$ which are not isomorphic to the whole space? In this paper an example is given of a closed infinite-dimensional subspace of l^1 which is not isomorphic to l^1.

803

Hebrew U. Dept. of Physics, Jerusalem (Israel).

OPTICAL PROPERTIES OF PARAMAGNETIC SOLIDS, by W. Low. Aug. 1959 [27]p. incl. diagrs. tables, refs (Technical note no. 10) (AFOSR-TN-60-168) (AF 61(052)59) AD 233360; PB 145862 Unclassified

Also published in Quantum Electronics; a Symposium, High View, N. Y. (Sept. 14-16, 1959), New York, Columbia U. Press, 1960, p. 410-427.

The transition groups discussed show absorption and fluorescence spectra characteristic of the particular ion and of the crystal surroundings. These absorption bands and lines are transitions between the Stark levels of the ground state and the Stark levels of the excited states. Ways in which the energy level schemes can be calculated for various symmetries are discussed. It is shown that good agreement between experiment and theory can be obtained by using only a few parameters. A review of the measured f numbers and fluorescent decay times, as well as the theoretical background, is presented for the iron and rare earth group. Certain regularities are shown to exist in the intensities of the absorption lines and line width of these transition groups. (Contractor's abstract)

804

Hebrew U. Dept. of Physics, Jerusalem (Israel).

PARAMAGNETIC AND OPTICAL SPECTRA OF YTTERBIUM IN THE CUBIC FIELD OF CALCIUM FLUORIDE, by W. Low. Jan. 1960, 7p. incl. diagrs. (Technical note no. 11) (AFOSR-TN-60-308) (AF 61-(052)59) AD 236303; PB 147109 Unclassified

Also published in Phys. Rev., v. 118: 1608-1609, June 15, 1960.

The paramagnetic resonance spectrum of ytterbium in calcium fluoride was observed at 20° K and 3 cm wavelength. The spectrum is described by a cubic spin Hamiltonian $\mathcal{H} = g\beta H \cdot S + AS \cdot I$ with $g = 3.426 \pm 0.001$, $S = 1/2$, $A^{171} = 886.5 \pm 1.5 \times 10^{-4}$ cm^{-1}, $A^{173} = 243.2 \pm 0.4 \times 10^{-4}$ cm^{-1}, $I^{171} = 1/2$, $I^{173} = 5/2$. The ratio of magnetic moments is $\frac{\mu^{173}}{\mu^{171}} = 1.374_9 \pm 0.005$. The optical spectrum shows lines of 9774, 9770, 9763A and more diffuse and unresolved bands at 9080 and 12730A. The paramagnetic spectrum is explained as arising from the Γ_7 doublet. The other levels are removed by at least a few cm^{-1} leading to an isotropic g value of 3Λ or $\frac{24}{7}$ for the lowest Γ_7 level. (Contractor's abstract)

805

Hebrew U. Dept. of Physics, Jerusalem (Israel).

PARAMAGNETIC RESONANCE SPECTRUM OF MANGANESE IN CORUNDUM, by W. Low and J. T. Suss. Feb. 1960, 7p. incl. refs. (Technical note no. 12) (AFOSR-TN-60-423) (AF 61(052)59) AD 236304; PB 147108 Unclassified

Also published in Phys. Rev., v. 119: 132-133, July 1, 1960.

The paramagnetic resonance spectrum of manganese in corundum was measured at 3 cm. The spectrum can be expressed in a spin Hamiltonian with trigonal symmetry with the following parameters: $g_{\parallel} = 2.0017 \pm 0.001$, $g_{\perp} = 2.000 \pm 0.002$, $D = +194.2 \pm 1$, $aF = +21.9 \pm 0.6$, $A = -79.6 \pm 0.5$, $B = -78.8 \pm 0.08$ in units of 10^{-4} cm^{-1}. (Contractor's abstract)

805

Hebrew U. Dept. of Physics, Jerusalem (Israel).

PARAMAGNETIC RESONANCE AND OPTICAL SPECTRA OF DIVALENT IRON IN CUBIC FIELDS. PART I. THEORY. PART II. EXPERIMENTAL RESULTS, by W. Low and M. Weger. May 1960, 1v. incl. diagrs. tables, refs. (Technical note no. 14) (AFOSR-TN-60-801) (AF 61(052)59) AD 241991; PB 150344 Unclassified

Also published in Phys. Rev., v. 118: 1119-1136, June 1, 1960.

Part I: The energy level splittings of the ground state of the d^6 configuration in cubic and axial fields are given. The Zeeman splittings of the various levels are calculated for weak and strong magnetic fields. In the case of tetrahedral symmetry the effect of the perturbations of the odd parity configurations of d^5p on the ground state is estimated. Part II: The paramagnetic resonance absorption of Fe^{2+} in MgO is observed at $g = 3.428$ and 6.86. The optical absorption line is found at 10,000 cm^{-1}. The paramagnetic resonance spectrum indicates considerable covalent bonding. The origin of the line at 6.86 is discussed. In tetrahedral ZnS a paramagnetic line is found at $g = 2.25$ and optical absorption at 3 μ and 0.7 μ. Possible explanations of this spectrum are discussed. A short discussion of the optical absorption spectra of trivalent iron in MgO is presented. (Contractor's abstract)

807

Hebrew U. Dept. of Physics, Jerusalem (Israel).

PARAMAGNETIC RESONANCE AND OPTICAL SPECTRUM OF IRON IN BERYL, by M. Dvir and W. Low. May 1960 [21]p. incl. diagrs. tables. (Technical note no. 13) (AFOSR-TN-60-994) (AF 61(052)59) AD 242258; PB 150355 Unclassified

Also published in Phys. Rev., v. 119: 1587-1591, Sept. 1, 1960.

The paramagnetic resonance spectrum of Fe^{3+} in beryl was measured at 20° and 290°K. In addition to this spectrum many weak lines were observed and possible explanations of these lines are discussed. The optical spectrum shows a spectrum characteristic of trivalent iron. In the infrared region there are several groups of sharp lines whose origin is not yet known. (Contractor's abstract)

808

Hebrew U. Dept. of Physics, Jerusalem (Israel).

PARAMAGNETIC RESONANCE SPECTRUM OF Mn^{2+} IN $ZnSiF_6{:}6H_2O$, $\Delta m = \pm 1$ TRANSITION, by E. Friedman and W. Low. June 1960 [12]p. incl. diagrs. tables. (Technical note no. 15) (AFOSR-TN-60-995) (AF 61(052)59) AD 242259; PB 150356 Unclassified

Also published in Phys. Rev., v. 120: 408-410, Oct. 15, 1960.

In the spectrum of Mn^{2+} in $ZnSiF_6{:}6H_2O$ a number of weaker lines are observed at intermediate angles of the magnetic field H with respect to the crystal axis, in addition to the 30 allowed transitions $\Delta m = \pm 1$, $\Delta m = 0$. These lines have been measured and assigned to $\Delta m = \pm 1$, $\Delta m = \pm 1$ transitions. The relatively strong intensity is explained and the intensity of the lines is shown to be proportional to $(D/A)^2 \cos^2 \theta \sin^2 \theta$. These forbidden transitions can be utilized for dynamic polarization of manganese nuclei. (Contractor's abstract)

809

Hebrew U. Dept. of Physics, Jerusalem (Israel).

EFFECT OF THERMAL TREATMENT OF PARAMAGNETIC RESONANCE SPECTRA OF RARE EARTH IMPURITIES IN CALCIUM FLUORIDE, by E. Friedman and W. Low. [1960] [2]p. incl. refs. (AFOSR-3092) [AF 61(052)59] Unclassified

Also published in Jour. Chem. Phys., v. 33: 1275-1276, Oct. 1960.

Previous work by the author showed that when trivalent rare-earth ions are substituted for Ca ions in CaF_2, the majority of the ions are situated at a site of cubic point symmetry. However, work by others indicated axial symmetry. Experiments carried out with CaF_2 crystals containing Gd demonstrated that in annealed crystals Gd showed axial symmetry. When such crystals were quenched from 1200° to room temperature in 1-2 hr, the axial symmetry spectrum disappeared and the cubic spectrum became stronger by a factor of 30.

810

Hebrew U. Dept. of Physics, Jerusalem (Israel).

PARAMAGNETIC RESONANCE SPECTRUM OF DYSPROSIUM IN THE CUBIC FIELD OF CALCIUM FLUORIDE, by W. Low. [1960] [2]p. (AFOSR-3093) [AF 61(052)59] Unclassified

Also published in Proc. Phys. Soc. (London), v. 76: 307-308, Aug. 1, 1960.

The spectrum of dysprosium in calcium fluoride is reported. The spectrum was measured at 20°K and at a frequency of 8766.7 mc/sec. One isotropic line was observed with half-width of about 30 gauss with

g= 7. 47 ± 0. 03. There is some indication that the line is broadened by spin-lattice relaxation. The ground state of dysprosium is $^6H_{15/2}$ and in the cubic field of calcium fluoride these levels split up into three quarters (Γ_8) and two doublets (Γ_6 and Γ_7). A method of approximating the Γ_7 doublet is given. It is shown that the dysprosium ion is not suitable for a Bloembergen type maser.

811

[Hebrew U. Dept. of Physics, Jerusalem (Israel)]

PULSED FIELD MEASUREMENTS OF LARGE ZERO-FIELD SPLITTINGS: V^{3+} IN Al_2O_3, by S. Foner and W. Low. [1960] [4]p. incl. diagrs. (AFOSR-3094) [AF 61(052)59] Unclassified

Published in Phys. Rev., v. 120: 1585-1588, Dec. 1, 1960.

Use of pulsed magnetic fields for determining large zero-field splittings of paramagnetic ions is considered. Measurements of zero-field splittings of over 50 cm^{-1} are feasible; a numerical example for S = 1 is discussed in order to indicate the present range and limitations of the method. The method is applied to measurements of the zero-field splitting of V^{3+} in Al_2O_3 at 4. 2°K and 1. 5°K. Assuming $g_{\|}$ = 1. 92, D = 7. 85 cm^{-1} was determined from experiments with 4 mm and 8 mm wavelength radiation and pulsed magnetic fields of the order of 100 kilogauss. The magnitude and sign of D are in good agreement with earlier estimates from optical and microwave measurements. (Contractor's abstract)

812

Hebrew U. Dept. of Physics, Jerusalem (Israel).

ABSORPTION LINES OF Cr^{3+} IN RUBY, by W. Low. [1960] [2]p. incl. diagrs. table. (AFOSR-3095) [AF 61(052)59] Unclassified

Also published in Jour. Chem. Phys., v. 33: 1162-1163, Oct. 1960.

The line spectrum of chromium in ruby was investigated. Ne lines were found at 14, 795, 14, 950, and 15, 178 cm^{-1} These lines were identified as belonging to the $^2F_1$ triplet. Similarly, a line at 21, 352 cm^{-1} was assigned to the $^2F_2$ triplet. It is shown that these levels originate from the ^2G and ^2D levels, respectively, with considerable admixture from the ^2H level. It is also shown that the F_1 level occurs at about 600 cm^{-1} higher frequency than the R lines. A number of diffuse and sharp lines appear in the ultraviolet in the region between 3350A, 3460A, and around 2900A, which are presumably transitions to Stark levels of excited doublet states.

813

Hebrew U. Dept. of Physics, Jerusalem (Israel).

PARAMAGNETIC RESONANCE SPECTRA OF IMPURITIES IN CALCIUM FLUORIDE, by M. Dvir and W. Low. [1959] 5p. (AFOSR-3096) (AF 61(052)59) Unclassified

Also published in Proc. Phys. Soc. (London), v. 75: 136-138, Jan. 1, 1960.

A few results concerning the spectra of various transition elements in calcium fluoride and in strontium chloride which differ significantly from results of Baker et. al. (Proc. Phys. Soc., v. 73: 943, 1959) are discussed. The single crystals were grown by the Stockbarger process in a purified helium atm at a dynamic pressure of slightly larger than one atm, the rate of lowering of the graphite crucible through the induction furnace being about 1/2 to 1-in./hr,, and were not annealed. A calcium fluoride lattice gave a strong spectrum characteristic of erbium consisting of one isotropic main line with g = 6. 785 ± 0. 002 and a well resolved hyperfine structure with I = 7/2 and A = 71. 2 ± 1 gauss due to the isotope Er^{167}. Baker et. al. reported that 5% of the erbium ions are situated at a site of cubic symmetry whereas these present results indicate that 90% of the trivalent ions are at such a site. In a sample of 0. 1% cerium the measured values of g = 3. 04 ± 0. 01 and g = 1. 386 are in good agreement with those of Baker. The spectrum of cobalt consisted of one sharp and slightly anisotropic line with maximum and minimum g values of 2. 010 ± 0. 002 and 2. 0035 ± 0. 002, respectively. In the same crystal Mn^2 was also present. The results of the spectrum of europium were also in good agreement with Baker et. al.

814

Hebrew U. Dept. of Physics, Jerusalem (Israel).

OPTICAL SPECTRA OF Eu^{2+} AND Gd^{3+} IN CaF_2, by W. Low. [1960] [2]p. incl. diagrs. (AFOSR-3097) [AF 61(052)59] Unclassified

Published in Nuovo Cimento, Series X, v. 17: 607-608, Aug. 16, 1960.

The spectra of Eu^{2+} and Gd^{3+} in a single crystal of CaF_2 are described. The absorption lines observed in the case of Eu^{2+} indicate that there are transitions within the f^7 configuration. This seems to be the first time that transitions within the configuration have been definitely observed for this ion. The ground state of both ions is $^8S_{7/2}$. Both ions can be substituted for Ca in the lattice of CaF_2. Paramagnetic resonance

has shown that Eu^{2+} is situated at a site of cubic symmetry. Gd^{3+} can be situated either at a site of cubic or axial symmetry. (Contractor's abstract)

815

Hebrew U. Dept. of Physics, Jerusalem (Israel).

PARAMAGNETIC RESONANCE SPECTRA OF RARE-EARTH IONS IN CUBIC CYSTALLINE FIELDS, by W. Low. [1960] [2]p. [AF 61(052)59] Unclassified

Published in Proc. Seventh Internat'l. Conf. on Low Temperature Phys., Toronto U. (Canada) (Aug. 29-Sept. 3, 1960), Toronto U. Press, 1961, p. 140-141.

The rare earth ions in cubic field symmetry involving only two crystal field parameters are studied. The spectra of Ce^{3+}, Dy^{3+}, Eu^{2+}, Gd^{3+}, Er^{3+}, Yb^{3+}, and Nd^{3+} have been observed at 20°K and 4°K. In several cases g fractions of more than one Stark level have been detected. All data indicate that the various doublet and quartet levels are closely spaced. Some of these ions can be used for adiabatic demagnetization.

816

Hebrew U. Dept. of Physics, Jerusalem (Israel).

THE DETERMINATION OF THE SIGN AND MAGNITUDE OF THE QUADRUPOLE INTERACTION CONSTANT FROM PARAMAGNETIC RESONANCE SPECTRA, by W. Low. [1960] 6p. [AF 61(052)59] Unclassified

It is shown that the spin Hamiltonian to second order contains, in addition to the direct effect of the external magnetic field on the nucleus, βBnH.I, a term R H·I.

R is a tensor with the same principal axes as the crystal field and involves matrix elements of the excited state. The sign of the quadrupole interaction can only be determined if the sign and magnitude of R are known. (Contractor's abstract)

817

Hebrew U. Dept. of Physics, Jerusalem (Israel).

HYPERFINE STRUCTURE OF TECHNETIUM^{99} FROM PARAMAGNETIC RESONANCE, by W. Low and P. M. Llewellyn. [1960] [9]p. incl. diagr. [AF 61(052)59] Unclassified

The hyperfine structure of tetravalent Tc^{99} in a single crystal of K_2PtCl_6 was detected at 1.25 cm wavelength and at the temperature of the boiling poing of liquid helium. The significant parameters are g = 1.9896 ± 0.0005 A_{max} = 148.8 ± 0.4 gauss, and A_{min} = 144.0 ± 0.4 gauss The nuclear spin is confirmed as 9/2. An additional 6 isotropic lines with g = 2.050 ± 0.005 and A = 109 ± 3 gauss are found at liquid nitrogen temperature. These hyperfine lines may be due to the rhenium isotopes 185 and 187 with nuclear spins of 5/2. (Contractor's abstract)

818

Hebrew U. Dept. of Physics, Jerusalem (Israel).

NUCLEAR RESONANCE ABSORPTION IN Dy^{161} SITUATED IN Dy_2O_3 AND DYSPROSIUM IRON GARNET, by S. Ofer, P. Avivi and others. July 1960 [12]p. incl. diagrs. (Technical note no. 1) (AFOSR-TN-60-1041) (AF 61(052)347) AD 244381 Unclassified

Also published in Phys. Rev., v. 120: 406-408, Oct. 15, 1960.

The recoil-free resonant absorption of the 26 kev γ-ray ($\tau \sim 4 \times 10^{-8}$ sec) emitted in the decay of Tb^{161} by absorbers containing Dy^{161} was investigated. High Mossbauer efficiencies at room temperature were observed for sources and absorbers in the form of oxide and rare earth iron garnet. The line shapes obtained were very broad, even up to 100 times the natural width, and showed no resolved sharp lines. The broad lines are interpreted as due to a wide complicated hyperfine spectrum whose details were smoothed out by transitions between magnetic sub-levels induced by paramagnetic relaxation. In the rare earth iron garnet, the exchange field acting on the rare earth ion should decouple the nuclear and electron spins. The effective magnetic field at the nucleus in the rare earth garnet is about 2×10^6 oe. (Contractor's abstract)

819

Hebrew U. Dept. of Physics, Jerusalem (Israel).

STUDY OF THE INTERNAL FIELDS ACTING ON IRON NUCLEI IN IRON GARNETS, USING THE RECOIL-FREE ABSORPTION IN Fe^{57} OF THE 14.4-KEV GAMMA RADIATION FROM Fe^{57m}, by R. Bauminger, S. G. Cohen and others. Dec. 1960, 18p. incl. diagrs. tables, refs. (Technical note no. 2) (AFOSR-225) (AF 61(052)347) AD 251235 Unclassified

Also published in Phys. Rev., v. 122: 743-748, May 1, 1961.

The shape of the recoil-free absorption spectrum obtained in iron garnet absorbers has been investigated, using, as a source, a Co^{57} source embedded in stainless steel. The results confirm the existence of two iron sublattices showing a Zeeman structure characterized by different parameters. No significant differences have been detected between the Zeeman structure in yttrium iron garnet and dysprosium iron garnet. The values obtained for the effective magnetic field at the Fe^{57} nuclei at room temperature are 3.90×10^5 oe and 4.85×10^5 oe for the d and a iron lattice sites, respectively. At liquid air temperature

the corresponding fields are 4.6×10^5 oe and 5.4×10^5 oe, respectively. The mean value of the chemical shift for the d sites relative to stainless steel is about 0.04 ± 0.005 cm/sec and about 0.06 ± 0.005 cm/sec for the a sites. (Contractor's abstract)

820

Heidelberg U. Pharmacology Inst. (Germany).

FATE OF INTRACELLULAR RADIOACTIVE PHOSPHORUS, SODIUM, POTASSIUM WILL BE STUDIED IN ENDOTHEL-LINED CAVITIES MEASURING THE OUTFLOW OF SUCH TRACERS INTO THE PERFUSION FLUID, by F. Eichholtz and K. Alexander. Final technical rept. Nov. 1, 1956 - Aug. 31, 1959 [5]p. incl. diagrs. (AFOSR-TR-60-56) (AF 61(514)-1006) AD 244809 Unclassified

In early periods of inflammation the fluid in the Selye-granuloma of the rat is readily exchangeable with fluid in the circulation; this is true for proteins, electrolytes and glucose. In this early period Prednisolon leads to an increase in the sugar content of the vesicle as a consequence of the increased blood sugar. On the other hand the total amount of fluid in this period is diminished by Prednisolon. The Selye-granuloma in a later phase of inflammation gives a new model for estimation of the glucose consumption by the granulomatous tissue and it is possible to measure the fate of other energy producing substances. Cortisones increase sugar consumption of the granuloma. The mechanism of this increase is still unknown. (Contractor's abstract)

821

Henri-Rousselle Hospital, Paris (France).

TYMPANIC MUSCLES AND CONTROL OF AUDITORY INPUT DURING AROUSAL, by A. Hugelin, S. Dumont, and N. Paillas. [1959] [2]p. incl. illus. (AFOSR-1644) (AF 61(052)229) Unclassified

Published in Science, v. 131: 1371-1372, May 6, 1960.

A reticular stimulation producing a powerful arousal reaction decreases the potential in the cochlear nucleus evoked by a click. This reduction results from the contraction of the middle ear muscles, which lessens the pressure transmitted to the cochlea, and is not due to a direct neural inhibitory effect at the level of the first synapse of the auditory pathway. (Contractor's abstract)

822

Hull U. Dept. of Chemistry (Gt. Brit.).

THE INHIBITION OF THE HYDROGEN-OXYGEN-REACTION BY METHANE, by R. R. Baldwin, D. Booth and others. [1960] [28]p. incl. diagrs. table, refs. (AFOSR-TN-60-298) (AF 61(052)62) AD 241393; PB 150039 Unclassified

Also published in Trans. Faraday Soc., v. 56: 302-814, June 1960.

This report describes the mechanism of inhibition by methane and accounts for the difference in methane inhibition and that of higher hydrocarbons. In the case of ethane and propane, the reduction in explosion pressure with increasing hydrocarbon mol fraction was almost linear down to the junction of the first and second limits. This was not so for methane. In KCl-coated vessels, the inhibition coefficient (i_c) was independent of mixing time over the range 0.25 - 5 min at 540°C and 500 mm Hg. In clean vessels at 500°C, a slight decrease (about 10%) was observed in i_c over the same time interval. Thus, using the withdrawal method, little error is introduced by adopting mixing periods of one min or less, even in clean vessels. In testing for the effect of oxygen mol fraction (y), the i_c - y relation was effectively linear through the origin at low y, falling off slightly at higher values, in the largest vessel. In the smaller vessels, the extrapolated curve made a positive intercept on the y axis due almost certainly to surface destruction of H atoms at low mol fractions of O_2. The variation of i_c with variation hydrogen mol fraction (x) was quadratic, being almost linear at low x, rising to a maximum, and falling again at the highest values of x. In both clean and KCl-coated vessels, variation of critical explosion pressure (P_c) with composition gave results in similar ranges which were considered to be of doubtful significance. The effect of vessel diameter, however, was quite marked in both clean and KCl-coated vessels. The effects of temperature and vessel surface were also investigated. The kinetic results were shown to differ from those of ethane and propane in the following respects: (1) The sharp transition, from explosion at pressures just below the uninhibited limit to a complete suppression of explosion contrasts with the continuous linear relation with ethane and propane. (2) A more marked effect of H_2 mol fraction is obtained in the case of CH_4. (3) A pronounced effect of vessel diameter is obtained in the case of CH_4, and none for ethane and propane.

823

Hull U. Dept. of Chemistry (Gt. Brit.).

THE SLOW REACTION BETWEEN HYDROGEN AND OXYGEN IN BORIC-ACID-COATED VESSELS, by R. R. Baldwin and L. Mayor. [1959] [13]p. incl. diagrs. refs. (AFOSR-TN-60-1291) (Sponsored jointly by [Air Force Office of Scientific Research under AF 61-(052\62]; Imperial Chemical Industries, Ltd., Royal Society, and Shell Research, Ltd.) AD 246876 Unclassified

Also published in Trans. Faraday Soc., v. 56: 80-92, Jan. 1960.

At 500 degrees C and 500 mm Hg, the rate of reaction of a given $H_2 + O_2$ mixture in a vessel freshly coated with boric acid is quite slow. The rate increases slightly as the vessel ages until a critical point is

reached when the rate increases rapidly over a short period of time, reaching a rate about thirty times faster than the original rate. The rapid reproducible reaction has been attributed to the inertness of the aged surface for the destruction of both HO_2 and H_2O_2. As a result, the HO_2 radicals form H_2O_2, either at the vessel surface or in the gas phase and the H_2O_2 then predominantly dissociates to form OH radicals. The induction period is attributed to the time for the build-up of the H_2O_2 concentration. Chain termination occurs mainly through reaction of H atoms with H_2O_2, although a reaction of either OH or O with H_2O_2 is also required. The whole mechanism is thus of the linear branching, self-terminating type. A more detailed explanation indicates the necessity of introducing a small contribution from a reaction between HO_2 and H_2 and this in turn suggests the occurrence of a gas-phase reaction between HO_2 radicals. The significance of these conclusions in relation to the existing mechanism of the $H_2 + O_2$ reaction is discussed.

824

Hull U. Dept. of Chemistry (Gt. Brit.).

THE MECHANISM OF THE HYDROGEN + OXYGEN REACTION IN AGED BORIC-ACID-COATED VESSELS, by R. R. Baldwin and L. Mayer. [1959] [12]p. incl. diagrs. table, refs. (AFOSR-TN-60-1292) (Sponsored jointly by [Air Force Office of Scientific Research under AF 61(052)62], Imperial Chemical Industries, Ltd., Royal Society, and Shell Research, Ltd.) AD 246874 Unclassified

Also published in Trans. Faraday Soc., v. 56: 103-114, Jan. 1960.

A detailed analysis has been made of the slow reaction data presented in an earlier paper (item no. 823, Vol. IV) so as to establish details of the reaction mechanism between H_2 and O_2 in boric-acid-coated vessels. The mechanism adopted provides a precise interpretation of the variation of maximum rate with mixture composition, total pressure, inert-gas addition and vessel diameter. It also interprets successfully both the absolute magnitude of the induction periods, and their variation with experimental factors. (Contractor's abstract)

825

Hull U. Dept. of Chemistry (Gt. Brit.).

THE SECOND LIMIT OF THE HYDROGEN + OXYGEN REACTION IN BORIC-ACID-COATED VESSELS, by R. R. Baldwin, L. Mayer, and P. Doran. [1959] [10]p. incl. diagrs. table, refs. (AFOSR-TN-60-1293) (Sponsored jointly by [Air Force Office of Scientific Research under AF 61(052)62], Imperial Chemical Industries, Ltd., Royal Society, and Shell Research, Ltd.) AD 246875 Unclassified

Also published in Trans. Faraday Soc., v. 56: 93-102, Jan. 1960.

The preceding study (item no. 823, Vol. IV) of the slow reaction between H_2 and O_2 in aged boric-acid-coated vessels has provided convincing evidence against the occurrence of the reaction $HO_2 + H_2O_2$ yields $H_2O + O_2 + OH$ in the temperature range 470-540°C. This reaction is an essential feature of the existing mechanisms to explain the quadratic branching characteristics of the $H_2 + O_2$ reaction in boric-acid-coated vessels, since it controls the concentration of H_2O_2 and hence the initiation rate. The present paper shows that by introducing the reaction $H + HO_2$ yields 2OH into the mechanism given for the slow reaction in aged boric-acid-coated vessels, an expression is obtained which accounts, in a more precise manner than previous mechanisms, for the second limit observations over a wide range of hydrogen and oxygen mol fractions. (Contractor's abstract)

826

Hull U. Dept. of Chemistry (Gt. Brit.).

A PRELIMINARY STUDY OF THE WATER-CATALYSED OXIDATION OF CARBON MONOXIDE, by R. R. Baldwin, D. Booth, and C. T. Brooks. Oct. 1960 [25]p. incl. diagrs. tables, refs. (Technical note no. 2) (AFOSR-TN-60-1348) (AF 61(052)62) AD 254326; PB 155691 Unclassified

The oxidation of moist CO mixtures has been studied in HNO_3- and HF-washed pyrex, HNO_3-washed silica, and fresh and aged boric-acid-coated vessels. The reaction is highly reproducible in aged boric-acid-coated vessels, and a detailed study of the slow reaction and second limit has been made. The effects of vessel surface, mixing time, withdrawal rate, pressure variation, carbon monoxide, oxygen, carbon dioxide, vessel diameter, water vapor, inert gas, and temperature were all investigated to help elucidate the mechanism. Several mechanisms are presented as possibilities.

827

Hull U. Dept. of Chemistry (Gt. Brit.).

THE DISSOCIATION OF HYDROGEN PEROXIDE AND ITS ROLE IN THE HYDROGEN-OXYGEN REACTION, by R. R. Baldwin, P. Doran, and L. Mayer. [1960] [7]p. incl. diagrs. refs. [AFOSR-2493] (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)62, Imperial Chemical Industries, Ltd., Royal Soc., and Shell Research, Ltd.) Unclassified

Also published in Eighth Symposium (Internat'l.) on Combustion, California Inst. of Tech., Pasadena (Aug. 28-Sept. 3, 1960), Baltimore, Williams and Wilkins Co., 1962, p. 103-109. (AFOSR-TR-60-127)

A review is presented of much of the research

concerning hydrogen peroxide's intermediate role in photochemical and thermal reactions between H_2 and O_2. Aged boric-acid-coated vessels were used to study the reactions because the reaction proceeds quite rapidly at 500°C. One point resolved here is that the reaction between H atoms and H_2O_2 should be written $H + H_2O_2 = H_2O + OH$ and not $H + H_2O_2 = H_2 + HO_2$. It is pointed out that detailed analysis gives some support to the reaction $OH + H_2O_2 = H_2O + HO_2$ over the reaction $O + H_2O_2 = H_2O + O_2$. Support is provided by the agreement of the values of k_{15}/k_1 obtained from studies of the H_2/O_2 reaction, and from peroxide decomposition studies in the presence of H_2. Discussion is also given of the role of H_2O_2 at the second limit. A self-consistent scheme for the slow reaction and explosion in aged-boric-coated vessels is obtained. $2HO_2 = H_2O_2 + O_2$ and $H + H_2O_2 = H_2 + HO_2$.

828

Hull U. [Dept. of Chemistry] (Gt. Brit.).

COMBUSTION STUDIES AT HULL UNIVERSITY (Abstract), by R. R. Baldwin. [1960] [2]p. (AF 61(052)-62) Unclassified

Presented at First AFOSR Contractors meeting on Chemical Kinetics of Propulsion, General Dynamics Corp., General Atomic Div., San Diego, Calif., Sept. 6-7, 1960. (AFOSR-TN-60-1063; AD 246174)

This investigation is an extension of previous work which showed that a rapid and reproducible slow reaction between hydrogen and oxygen could be obtained at low temperatures in a boric-acid-coated vessel that had been "aged" by repeated kinetic results. Assuming that this aged surface is inert towards H_2O and H_2O_2, studies have been made of the second limit in these vessels over a range of temperatures and evidence has been collected indicating the importance of H_2O_2 as an intermediate. Studies have also been performed on the inhibition of the hydrogen-oxygen reaction by hydrocarbons, the reaction of Co with H, OH, O, and H_2O, and the H_2O-catalyzed oxidation of Co.

829

Human Sciences Research, Inc., Arlington, Va.

A BIBLIOGRAPHY OF SMALL GROUP RESEARCH, by A. Terauds, I. Altman, and J. E. McGrath. Apr. 1960, 219p. incl. refs. (Rept. no. HSR-RR-60/2-Gn) (AFOSR-TN-60-365) (AF 49(638)256) AD 237304; PB 147835 Unclassified

This report is one of several that have been generated in an ongoing program to integrate small group research knowledge. The major objective of the program is the development of methods which will allow for the systematic organization of knowledge in this field. As one aspect of this work, the present report contains a comprehensive bibliography of small group research studies current through 1959. Only selected group psychotherapy studies are included, namely, those dealing directly with small group methods, concepts, etc. Masters and doctoral theses have been omitted because of their relative unavailability to most researchers. Furthermore, only studies written in the English language have been included because access to foreign journals was too limited to build a sufficient bibliography of such research. An addenda of recent studies appears at the end of the bibliography.

830

Human Sciences Research, Inc., Arlington, Va.

MAJOR VARIABLES OF THE SMALL GROUP FIELD, by I. Altman and A. Terauds. Nov. 1960, 729p. incl tables, refs. (Rept. no. HSR-RR-60/6-Gn) (AFOSR-TN-60-1207) (AF 49(638)256) AD 250746 Unclassified

A program to integrate small group research knowledge is described. The objective of the program is to develop methods for the organization of knowledge in the small group field. As one facet of this work, major variables of the field are reviewed. The review includes descriptions of variable subclasses, information about rates of appearance, and results of each variable's association with other variables. In addition, a special review of individual and group performance effectiveness variables is presented. (Contractor's abstract)

831

Human Sciences Research, Inc., Arlington, Va.

ANNOTATIONS OF SMALL GROUP RESEARCH STUDIES, by I. Altman, C. Pendleton, and A. Terauds. Oct. 1960, 761p. incl. diagrs. tables, refs. (Rept. no. HSR-RR-60/5-Gn) (AFOSR-TN-60-1208) (AF 49(638)-256) AD 248440; PB 154151 Unclassified

This report of study annotations is divided into 3 major sections. The first describes sampling procedures and general actuarial characteristics of the review studies. The next section presents the annotation procedures and discusses how to make use of the annotations. The third and major section of the report contains the individual study annotations, each of which specifies study purpose, study procedure, research results, and variables. This section also contains a special review of 50 studies having relationships which are concerned with individual and group effectiveness. Finally, a last section is a list of existing and soon forthcoming reports of the research program.

832

Human Sciences Research, Inc., Arlington, Va.

AN INVENTORY OF SELECTED SOURCE MATERIALS

RELEVANT TO INTEGRATION OF PHYSICAL AND SOCIAL EFFECTS OF AIR ATTACK, by R. D. Popper and W. A. Lybrand. Oct. 1960, 1v. incl. refs. (Rept. no. HSR-RR-60/4-Se) (AFOSR-TN-60-378) (AF 49-(638)549) AD 244888 Unclassified

As part of research being conducted toward the development of an analytic model that integrates the major physical and social effects of nuclear attack, a large number and variety of source materials were reviewed. It seemed apparent that the review was producing information that might be of value above and beyond its immediate use in the program. Thus, it was decided to prepare this inventory for interested researchers, with the hope that it would serve as a time-saving, single-volume guide to source materials which might be used in similar or related programs. The inventory is divided into three major sections: (1) the problem includes studies or treatises dealing with thermonuclear warfare and its effects; (2) societal behavior under stress encompasses studies of World War II bombing attack effects, the effects of major disasters on societal functioning, and studies of individual and small group reactions to stress; and (3) analytic methods contains reports of analytic approaches used on aspects of the problem, or on similar problems, and a number of applications of analytic models which seem to yield insights into the usefulness of those types of models to the present research program.

833

Human Sciences Research, Inc., Arlington, Va.

SOCIAL PHENOMENA IN A POST-NUCLEAR ATTACK SITUATION; SYNOPSES OF LIKELY SOCIAL EFFECTS OF THE PHYSICAL DAMAGE, by P. G. Nordlie and R. D. Popper. Aug. 1961 [110]p. incl. diagr. table, refs. (Rept. no. HSR-RR-61/2-Se) (AFOSR-TN-60-1495) (AF 49(638)549) AD 263211 Unclassified

The function of the present report is to help formulate assumptions and identify variables which need to be taken into account in making predictions about the recovery of a social system from the effects of a nuclear attack. It is estimated that the behavior of people in a post-nuclear situation generally will be adaptive rather than maladaptive. Ignorance of what actions are appropriate will tend to reduce the amount of adaptive behavior actually displayed. Wide spread mass panic will not occur. The major psychological response to the attack will be extreme fear. These feelings are likely to persist for relatively long periods of time. The psychological state of most survivors directly affected by the attack will be quiet, passive, docile, and fairly responsive to direction and control exercised by persons of authority for a considerable period of time after the initial direct effects of the explosion have subsided. This will slowly give way to a more highly active energy state, probably characterized by the expression of some hostility and blame toward government authorities. People directly affected will experience role conflict between the demands of their family and of their normal job. In general, people will resolve the conflict in favor of their families and at the expense of other obligations and responsibilities. Among survivors in contact with each other, there will be an increase in communication and a general lowering of barriers to personal intercommunication. An immediate effect of the attack will be to produce a sudden shift in the priority of values by which people govern their behavior. The highest and most salient value will become that of achieving the safety and survival of oneself and immediate family. Except for the shift in priority of values noted above social norms which govern the normal relationships between people will not be seriously altered, at least for a considerable period of time after the attack. The activities of survivors will be directed at obtaining the basic requirements - for existence - food, water, etc. -- for themselves and their families. For weeks and perhaps months after the attack, survivors in directly affected areas will require almost their entire time and energy for obtaining basic needs of living.

834

Human Sciences Research, Inc., Arlington, Va.

OUTLINE OF AN ANALYTIC APPROACH TO PREDICTING SOCIETAL SYSTEM RECOVERY FROM AN AIR ATTACK, by W. A. Lybrand. Mar. 1961, 46p. incl. diagrs. refs. (Rept. no. HSR-RR-61/1-Se) (AFOSR-TN-60-1496) (AF 49(638)549) AD 255770 Unclassified

The ultimate objective of the present research program is development of a recovery-prediction system that integrates both physical and social effects of thermonuclear air attack. Recovery as an over-all goal in such a situation is defined as the successive accomplishment of 3 separate subgoals: (1) viability of the surviving society; this refers to the minimum bedrock requirements for human survival (e.g., amounts of food, shelter, clothing), (2) development and maintenance of a war-waging capability, and (3) longer-range ideological, cultural, and societal goals. The particular potential applications of the predictive system are concerned primarily with the first 2 subgoals. It is important to note, however, that those pre-attack ideological, cultural, and societal factors which are important determinants of viability and war-waging capability are of direct concern to the inquiry. (Contractor's abstract)



835

Illinois Inst. of Tech. Armour Research Foundation, Chicago.

A SPLIT-TEMPERATURE COLUMN SYSTEM FOR GAS CHROMATOGRAPHIC ANALYSES, by P. Y. Feng and B. K. Krotoszynski. [1960] [2]p. incl. diagr. (AF 18(603)121) Unclassified

Published in Nature, v. 188: 311-312, Oct. 12, 1960.

The speed and resolution in gas chromatographic analyses has been improved by means of a split-temperature column system which has provisions for 2 or more different temperature regions in the same unit and which provides a means of rapid temperature change in these areas. Such a system includes a single low-temperature system, a single high-temperature system, as well as a temperature-programmed system. The split-temperature column permitted the separation of 11 components in a time period of 20 min with the resolutions of the low-boiling components comparing favorably with those obtained by a low-temperature column, and the resolution of the high-boiling components comparing favorably with those obtained by the high-temperature column. The split-temperature column, which can be constructed easily and inexpensively, permits the analysis of a larger number of samples per chromatograph and the use of one single long column for each type of packing.

836

Illinois Inst. of Tech. [Armour Research Foundation] Chicago.

LOW ENERGY ELECTRONS IN RADIATION CHEMISTRY (Abstract), by P. Y. Feng. [1960] [1]p. [AF 18-(603)121] Unclassified

Published in Trans. Amer. Nuclear Soc., v. 3: 356, Dec. 1960.

Proper understanding of various radiation chemical phenomena requires an understanding of the details of the mode of formation of low energy electrons as well as the nature of the interaction of these electrons with matter. Considerations along these lines permit a better estimation of the relative extent of ionization and electronic excitation of the various parts of a molecule and suggest a potentially more successful approach to correlate radiation chemical data with those obtained in photo-chemical or mass spectrometric research. These considerations also show that there exist substantial radiation dose variations in many laboratory scale irradiated samples over and beyond those expected from absorption or geometry factors, indicating the desirability of re-examining those radiation chemical data which are dose rate dependent.

837

Illinois Inst. of Tech. [Armour Research Foundation] Chicago.

THE RADIOLYSIS OF SOME SOLID METAL ACETATE (Abstract), by P. Y. Feng and J. B. Hamilton. [1960] [1]p. incl. table. [AF 18(603)121] Unclassified

Published in Trans. Amer. Nuclear Soc., v. 3: 388, Dec. 1960.

The radiolysis of the acetates of a number of bivalent metals in the solid state yields hydrogen, carbon monoxide, carbon dioxide, methane and ethane as the major gaseous products. The production of these gases is appreciably affected by the nature of the inorganic ion as well as the presence or absence of water of hydration. Results show that the products are formed more copiously when the acetates are hydrated. Among the hydrated acetates, the yield of the gaseous products, particularly CO_2, is clearly affected by the nature of the metal ion.

838

Illinois Inst. of Tech. Armour Research Foundation, Chicago.

PRESSURE EFFECTS IN LUMINESCENCE. III. CLASSICAL ESTIMATES, by L. Reiffel. [1960] [2?]p. incl. diagrs. tables, refs. (Technical note no. 4) (AFOSR-TN-60-1119) (Also bound with its AFOSR-TR-60-128 as Appendix I; AD 245196) (AF 49(638)113) AD 245196 Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago U., Ill., Nov. 25-26, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 416, Nov. 25, 1960.

Equations required for estimates on the magnitude of various pressure-induced effects are discussed. The effects treated include quantum efficiency for and mean life of a metastable state, lifetime and quantum efficiency of a thermally quenched emitting state, emission band position and width, emission from communicating levels, and cross-over probability. (Contractor's abstract, modified)

839

Illinois Inst. of Tech. Armour Research Foundation, Chicago.

PRESSURE EFFECTS IN LUMINESCENCE, by L. Reiffel. Final rept. Sept. 16, 1960, 28p. incl. diagrs. tables, refs. (AFOSR-TR-60-128) (AF 49(638)113) AD 245196; PB 152731 Unclassified

This report presents abstracts of work done under contract AF 49(638)113. Various aspects of the general topic, pressure effects in luminescence, have been

investigated, including isobaric experiments on NaI(Tl), configuration coordinate models of KCl(Tl), and luminescence of activated alkali halides.

840

Illinois Inst. of Tech. Armour Research Foundation, Chicago.

PRESSURE EFFECTS IN THE LUMINESCENCE OF ACTIVATED ALKALI HALIDES (Abstract), by R. M. Norton and L. Reiffel. [1960] [1]p. [AF 49(638)113] Unclassified

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 201, Mar. 21, 1960.

Investigation of the effects of pressure on the phosphorescent decay of activated alkali halides is continuing. The response of NaI(Tl), excited by Ir^{192} gamma radiation, for pressures up to 50,000 psi has already been reported (item no. 663, Vol. III). Observations on single crystal CsBr(Tl), KI(Tl), KCl(Tl), and NaCl(Ag) will be presented over a comparable range of pressures. As expected, the thallium-activated materials are qualitatively similar while the phosphorescence of NaCl(Ag) exhibits appreciable pressure sensitivity only after about 20 min of decay at 18°C.

841

Illinois Inst. of Tech. Armour Research Foundation, Chicago.

ORGANIC SEMICONDUCTORS, by D. E. Laskowski, E. H. Tompkins, and O. W. Adams. Quarterly rept. Dec. 1959, 40p. incl. diagrs. tables, refs. (Rept. no. ARF 3142-1) (AFOSR-TN-60-63) (AF 49(638)576) AD 232120; PB 161459 Unclassified

The following areas of organic semiconductor research have been considered: (1) preparation of molecular addition compounds as possible semiconductors, (2) preparation of solids containing elements or compounds capable of conduction by oxidation-reduction, and (3) measurement of conductivity and mobility. The strength of the bonding in molecular addition compounds depends on the extent of overlapping of the donor and acceptor molecules. Means of improving the possibility of overlapping are considered. Specimens of these molecular complexes are prepared as single crystals in order to measure their electrical properties. Polytributyltin methacrylate has been prepared and evaluated. Its resistivity is found to decrease considerably when exposed to iodine vapors. Approximate conductivities have been measured and a special apparatus has been assembled to obtain more precise values. Hall coefficients of the materials being prepared must also be measured in order to determine the mobility, which is proportional to the product of conductivity and Hall coefficient. (Contractor's abstract)

842

Illinois Inst. of Tech. Armour Research Foundation, Chicago.

PREPARATION, CHARACTERIZATION AND PHYSICAL AND CHEMICAL PROPERTIES OF TETRAMETHYLAMMONIUM OZONIDE, by I. J. Solomon, A. J. Kacmarek and others. [1960] [2]p. incl. diagr. tables, refs. (AFOSR-TN-60-443) (AF 49(638)618) AD 247810 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 5640-5641, Nov. 5, 1960.

The new compound, tetramethylammonium ozonide, has been prepared by the reaction of tetramethylammonium hydroxide and gaseous ozone. Electron paramagnetic resonance measurements showed that the compound is a free radical with 1 unpaired electron. Its visible spectrum is very similar to those of the alkali metal ozonides which have wave length maximums near 450 mμ. The solubility of tetramethylammonium ozonide at -63° is 1.3 ± 0.1 g per 100 g of liquid ammonia. The heat of formation of the pure material was found to be 49.5 ± 4.2 kcal per mol. (Contractor's abstract, modified)

843

Illinois Inst. of Tech. Armour Research Foundation, Chicago.

AMMONIUM OZONIDE, by I. J. Solomon, K. Hattori and others. [1960] [3]p. incl. diagr. tables, refs. (AFOSR-TN-60-1377) (AF 49(638)618) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 84: 34-36, Jan. 5, 1962.

The new compound, ammonium ozonide, has been prepared by the low temperature ozonization of ammonia. It has the characteristic five-peaked ozonide spectrum which shows a maximum in the vicinity of 450 mu. The salt is thermally unstable and starts to decompose above -126°. Its decomposition products are ammonium nitrate, oxygen, and water. (Contractor's abstract)

844

Illinois Inst. of Tech. Armour Research Foundation, Chicago.

CONVERSION OF DIFFRACTOMETER FOR SMALL ANGLE SCATTERING, by R. H. Bragg and L. E. Copeland. Oct. 1, 1960 [27]p. incl. illus. diagrs. refs. (AFOSR-TN-60-1235) (AF 49(638)829) AD 245197; PB 152730 Unclassified

A simple, rapid conversion of a diffractometer from conventional diffractometry to small angle scattering is described. The conversion consists of adding an attachment which provides a larger separation between the slits limiting the angular divergence of the beam scattered by the sample which reaches the detector. Usable measurements can be made down to 0.10° 2Θ. Sample preparation requires only a few min and both solids and liquids are handled with equal facility. Intensity data are obtained by means of manual fixed count measurements and a complete pattern for most materials can be obtained in about 1 hr. The range of intensity encountered in materials, e.g., magnesite, colloidal graphite, silica gel, and silica sols can be as great as 10^4:1. This makes possible comparison of the experimental curves with theory for both small and large values of the scattering vector. (Contractor's abstract, modified)

845

Illinois Inst. of Tech. Armour Research Foundation, Chicago.

DEFECT CLUSTERS IN NEUTRON IRRADIATED LITHIUM FLUORIDE (Abstract), by R. H. Bragg. [1960] [1]p. (Bound with its AFOSR-732; AD 258384) (AF 49(638)829) Unclassified

Presented at meeting of the Amer. Ceramic Soc., Detroit, Mich., Sept. 27, 1960.

Defect clusters are formed in lithium fluoride irradiated with slow neutrons, the effective bombardment arising from the $Li^6(n,\alpha)H^3$ reaction. The clusters are characterized by means of small angle x-ray scattering. The size and shape of the clusters are deduced from the angular variation of the scattered intensity. In the irradiated compound the clusters were found to have a radius of gyration of about 10-15A. The angular variation of the intensity suggests a rod-like shape at low doses, but after annealing a plate-like shape is indicated. (Contractor's abstract)

846

Illinois Inst. of Tech. Armour Research Foundation, Chicago.

A NEW METHOD OF DETERMINING THE MOSAIC STRUCTURE OF CRYSTALS (Abstract), by R. H. Bragg and L. V. Azároff. [1960] [1]p. (Bound with its AFOSR-732; AD 258384) (AF 49(638)829) Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 25-26, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 421, Nov. 25, 1960.

The integrated intensity of reflections from mosaic crystals depends upon the crystallite tilt parameter, η, and the mean crystallite size, t_o. In the new method the analysis depends upon variation of the coefficient of reflection, Q, and the primary extinction function, $F(A_o)$ by varying the wavelength of the diffracted x-rays, λ. This variation is achieved by orienting the crystal so that a selected set of lattice planes of spacing, d, is inclined at angle θ relative to the direct beam which causes the desired wavelength to be reflected in accordance with Bragg's law. In order to place the intensities on an absolute basis the intensity distribution in the incident beam, $I_o(\lambda)$, is measured with a scintillation counter. Measurements have been made on a (111) plate of silicon using x-ray wavelengths in the range 0.37 to 1.18A. Etch pit counts at the edge and center portions of the plate were 3×10^6 and $5 \times 10^5/cm^2$, respectively. Corresponding crystallite sizes were found to be 9 and 3μ and the corresponding tilt parameters were 15 and 3 sec of arc. (Contractor's abstract)

847

[Illinois Inst. of Tech.] Armour Research Foundation, Chicago.

PHOTOCHEMICAL DECOMPOSITION OF OZONE (Abstract), by C. K. Hersh. [1960] [1]p. (AF 49(638)847) Unclassified

Presented at First AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, General Dynamics Corp., General Atomic Div., San Diego, Calif., Sept. 6-7, 1960. (AFOSR-TN-60-1063; AD 246174)

The thermal and photochemical decomposition rates of $O_{3(g)}$ as a method of determining the mechanism of the ozone decomposition are compared. Decomposition is studied over a range of pressures (less than 1.5 atm) and temperatures (less than 50°C). R_T (rate of thermal decomposition) and R_p (rate of photochemical decomposition may be expressed in terms of the Benson-Axworthy mechanism. It is then possible to show that: $\frac{R_p - R_T}{R_T} = \frac{k_p}{\Sigma k_1 [O_3]^2}$ and $R_p - R_T = 2k_p$ for the initial rate where the oxygen concentration is very nearly zero or at least small in comparison with the ozone concentration, the k_1 and k_p are rate constants for $O_3 + M \rightarrow O_2 + O + M$ and $O_3 + h\nu = O_2 + O$ respectively. The $[O_3]$ and M are the concentrations of ozone and other gases in the mixtures.

848

Illinois Inst. of Tech. Dept. of Chemistry, Chicago.

REACTIONS OF SILVER ACETYLIDES WITH ACYL PYRIDINIUM SALTS: N-BENZOYL-2-PHENYL ETHNYL-1, 2-DIHYDROPYRIDINE, by T. Agawa and S. I. Miller. Dec. 1959, 20p. incl. diagrs. tables, refs. (Technical rept. no. 2) (AFOSR-TN-60-156) (AF 49-(638)39) AD 234701 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 449-453, Jan. 20, 1961.

The reaction between certain halides, pyridine and silver acetylides leads to the system N-acyl 2-alkynyl-1,2-dihydropyridine(I) as well as acylacetylenes as coproducts. Basic hydrolysis of I gives the alkenyl-pyridines (III), RCH = CH(2-C_5H_4N), while potassium hyprobromite or acid hydrolysis gives the alkynes, RC ≡ C(2-C_5H_4N): these constitute new paths to these unsaturated compounds. Reaction of the diene (I) with maleic anhydride leads to the isoquinuclidine system (2-azabicyclo(2·2·2)-7-octene) from which the azabicyclo(2·2·2) octadiene can be made. (Contractor's abstract)

849

Illinois Inst. of Tech. Dept. of Chemistry, Chicago.

SYNTHESIS WITH CARBIDES, by S. I. Miller. Final rept. Feb. 1, 1957-Aug. 31, 1960. Sept. 1960 [6]p. (AFOSR-TR-60-137) (AF 49(638)39) AD 244490 Unclassified

The proposed attempted syntheses involved reaction of CaC_2 with RX, RR'CO, and RCH $\triangle$ CH_2 to form RC ≡ CR, RR'C(OH)C ≡ CC(OH)RR', and $(RCHOHCH_2C \geq C)_2$, respectively. Reactions were conducted in a variety of solvents with CaC_2 in the as-received state, or ignited to decompose any $CaCO_3$ or $Ca(OH)_2$ to CaO. The results were negative or inconclusive and indicated that CaC_2 is not useful for the direct introduction of the moiety -C ≡ C. In addition to the direct introduction of the C^{-4} fragment analogous to the CaC_2 reactions, attempts were made to trap other fragments by partial hydrolysis of Al_4C_3. Attempts to prepare halomethanes from halogens or tertiary alcohols from ketones were not successful. The direct synthesis of acyl acetylenes by reacting ArCl + $C_6H_5C \equiv CNa$ was unsuccessful. Reactions between anhydrous diazonium salts and RMg X, RLi, RNa, RAg, and Cu_2C_2 were attempted. Cuprous carbide appeared to be unreactive. The grignard reagents appeared to form complex mixtures. The reaction of silver acetylide and $C_6H_5N_2$ $^+BF_4^-$ lead to mixed products. Attempts were made to hydrogenate 1,4-diazobicyclo(2·2·2)-octane without success in order to obtain bicycol(2·2·2) octatrienes.

850

Illinois Inst. of Tech. Dept. of Chemistry, Chicago.

THE THERMODYNAMIC PROPERTIES OF Nb-H, V-H AND Ta-H, by E. Veleckis. Jan. 1960, 173p. incl. diagrs. tables, refs. (AFOSR-1107) (AF 49(638)346) AD 282433 Unclassified

The equilibrium pressure method was employed to determine the solubility of H in Group VB metals in the temperature range 250 to 650C, and for H pressures extending up to 1 atm. Only a single solid solution phase was found throughout the experimentally investigated regions. In all 3 systems, however, the shape of the low-temperature isotherms clearly indicated the existence of 2-phase immiscibility intervals. For all conditions, H was more soluble in Nb than it is in Ta or V. The solubility in Ta is higher than in V except for higher compositions, where the reverse is true. The maximum H solubility limits are independent of temperature and correspond to the atomic ratio 0.89 for Nb and V and 0.71 for Ta. Partial phase diagrams constructed for the 3 systems include the proposed boundaries of the heterogeneous 2-phase region. The thermodynamic properties determined from the experimental data were in good agreement with those calculated from the statistical model. (Contractor's abstract)

851

Illinois Inst. of Tech. Dept. of Metallurgical Engineering, Chicago.

AN X-RAY DIFFRACTION STUDY OF CRYSTAL PERFECTION IN SILICON, by R. H. Bragg and L. V. Azároff. June 24, 1960 [8]p. incl. diagrs. (AFOSR-TN-60-632) (AF 49(638)425) AD 239726; PB 148778 Unclassified

A modified Laue focusing arrangement was used to examine neighboring regions of a relatively perfect slice taken out of a Si ingot. Small variations in the line-width and the total diffracted intensity were observed for regions separated by about 2mm. Only short-wavelength x-radiation could show up small differences in crystal perfection. (Contractor's abstract, modified)

852

Illinois Inst. of Tech. Dept. of Metallurgical Engineering, Chicago.

DISTRIBUTION OF ELECTRONS IN CADMIUM SULFIDE CRYSTALS, by G. P. Mohanty and L. V. Azároff. July 19, 1960 [8]p. incl. diagrs. (AFOSR-TN-60-792) (AF 49(638)425) AD 240818; PB 149393 Unclassified

Presented at Diffraction Conf., Pittsburgh, Pa., Nov. 9-11, 1960.

Also published in Phys. Rev., v. 120: 1224-1225, Nov. 15, 1960.

The (0001) electron density projections were determined for a pure cadmium sulfide crystal having a high dark resistivity and one doped with chlorine having low resistivity. Extremely accurate intensities (± 2%) were obtained so that small variations in the electron distribution could be determined. It was found that the atoms in the doped crystal had larger effective sizes than in the undoped crystal. Also, the presence of a very small peak in an interstitial position of the structure suggests that some of the atoms occupy interstitial sites. This result differs markedly from an earlier investigation by Shuvalov [Dokladi Akad. Nauk, USSR, v. 109: 753, 1956 and Zh. Tekh. Fiziki, USSR, v. 26: 1870, 1956] who reports the formation of electron bridges between adjacent atoms in cadmium sulfide crystals having low dark resistivities. The results obtained in this investigation also differ from Shuvalov's in regard to variations in diffraction intensities of certain reflections. Possible reasons for these differences are discussed. (Contractor's abstract)

853

Illinois Inst. of Tech. Dept. of Metallurgical Engineering, Chicago.

ELECTRON DENSITY DISTRIBUTIONS IN ZnO CRYSTALS, by G. P. Mohanty and L. V. Azároff. Nov. 28, 1960 [13]p. incl. diagrs. table, refs. (AFOSR-TN-60-1352) (AF 49(638)425) AD 247831 Unclassified

Presented at Diffraction Conf., Pittsburgh, Pa., Nov. 9-11, 1960.

Also published in Jour. Chem. Phys., v. 35: 1268-1270, Oct. 1961.

Electron density distributions have been determined for doped and undoped ZnO crystals by x-ray diffraction measurements. Upon examination the doped crystals reveal 15 - 60 X 10^{19} atoms/cm^3 in the octahedral interstices. This large number of interstitial Zn atoms increases the axial ratio of the hexagonal unit cell from 1.6019 to 1.6025. The density of interstitials is approximately 1000 times greater than that calculated from the electrical conductivity of these crystals, indicating the neutrality of most of the atoms. The presence of these interstitials explains why the time required to reach saturation for electrical conductivity is much greater in virgin crystals, than in doped ones. (Contractor's abstract)

854

Illinois Inst. of Tech. Dept. of Metallurgical Engineering, Chicago.

THE ROLE OF CRYSTAL STRUCTURE IN DIFFUSION. I. DIFFUSION PATHS IN CLOSEST-PACKED CRYSTALS, by L. V. Azároff. Dec. 1, 1960 [20]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1353) (AF 49(638)425) AD 251755 Unclassified

Also published in Jour. Appl. Phys., v. 32: 1658-1662, Sept. 1961.

The crystal structures of simple binary compounds show that they can be represented by closest packings of the larger anions in which 2 kinds of interstices are available for occupation by the metal atoms. In hexagonal packings the octahedral voids form continuous chains by sharing opposite faces while the tetrahedral voids form isolated pairs. The specific diffusion paths available in these compounds depends on the manner in which the voids are filled. Continuous diffusion paths comprised of normally unoccupied voids exist in ZnO and α - ZnS type structures so that Noidal diffusion can occur without defect formation. Similarly, voidal diffusion can occur in BiO_3, Cr Cl_3, and CdI_2 type structures. Conversely, all possible continuous diffusion paths are blocked by metal atoms in the NiAs, NaCl, and antifluorite type structures so that vacancy or interstitialcy mechanisms are necessary for diffusion. (Contractor's abstract)

855

Illinois Inst. of Tech. Dept. of Metallurgical Engineering, Chicago.

THE ROLE OF CRYSTAL STRUCTURE IN DIFFUSION. II. ACTIVATION ENERGIES FOR DIFFUSION IN CLOSEST-PACKED STRUCTURES, by L. V. Azároff. Dec. 1, 1960, 9p. incl. refs. (AFOSR-TN-60-1354) (AF 49(638)425) AD 251756 Unclassified

Also published in Jour. Appl. Phys., v. 32: 1663-1665, Sept. 1961.

The effects of available diffusion paths on activation energies are considered for silver iodide, zinc oxide, and bismuth selenide. It is shown that the energy in β-AgI should be nearly twice that in γ-AgI since the Ag atoms in tetrahedral sides first must be dispaced to octahedral voids before voidal diffusion can occur in the β-modification. The 2:1 ratio between the self-diffusion energies of Zn determined by radioactive tracer and electrical conductivity measurements in ZnO is similarly explained. The difference between the activation energies for diffusion in BiSe and Bi_2Se_3 can be used to determine the formation energy of vacancies in BiSe. (Contractor's abstract)

856

Illinois U. Coordinated Science Lab., Urbana.

EXPERIMENTS ON THE PERFORMANCE OF AN AUTOMATIC AIR DEFENSE SYSTEM, by H. W. Sinaiko and L. Shpiner. Jan. 1960, 34p. incl. illus. tables. (Rept. no. R-113) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-56695) AD 231040 Unclassified

Three experiments were done with the Cornfield system, a complex computer system, operating in an air defense context in a fully automatic mode. In each experiment, the system was programmed to do automatic threat evaluation, weapon selection, and weapon control. The program, ICON II in the Illiac computer, also made automatic recordings of 4 aspects of system performance: target penetrations, target kills, kill distance, and weapon assignments. Experiment I studied the effects of 3 variables, and their interactions, on the system: target load, defense strategy, and number of weapons. Experiment II tested the hypothesis that data samples of 4 runs would yield the same results as samples of 10 runs of the Cornfield system. Experiment III tested the hypothesis that a particular script could be divided into three 10-min scripts and that results from each of these would be comparable with their counterparts in the longer script.

857

Illinois U. Coordinated Science Lab., Urbana.

THE SPECTRUM OF X-BAND RADIATION BACKSCATTERED FROM THE SEA SURFACE, by B. L. Hicks, N. Knable and others. [1960] [13]p. incl. diagrs. table, refs. (Sponsored jointly by [Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps] under DA-36-039-sc-56695) Unclassified

Published in Jour. Geophys. Research, v. 65: 825-837, Mar. 1960.

A coherent radar was used to measure the sea clutter or backscattering of X-band electromagnetic energy from the sea surface. More than 200 recorded samples of clutter were analyzed to give power spectra of the clutter. Each spectrum was displayed as a function of frequency and of position on the water surface and was also averaged to give the mean spectrum of patches 3750 ft long. Five of the samples showed an anomalous downwind displacement of the clutter by as much as 7 knots. The displays indicate that the upwind edge of the clutter spectrum is smooth for all wind speeds observed, but that the downwind edge, for sea state 3 or above, is broadened in an irregular fashion as a function of range. This irregular broadening implies a considerable variability, from patch to patch, in the downwind side of the probability distribution of velocity of scatterers on the sea surface. The width at half-power of a mean spectrum is proportional to the width at half-maximum of the probability distribution of scatterer velocities. An equation is given to represent this latter width; the equation fits the experimental data within about 10% for bandwidths in the range of 2 to 5 knots and wind speeds in the range of 8 to 19 knots. The bandwidth of the clutter is found to be approximately proportional to the wind speed. The relationships of clutter bandwidths to wave and whitecap velocities, radar depression angle, and wind direction are also discussed. (Contractor's abstract, modified)

858

Illinois U. Coordinated Science Lab., Urbana.

ON MARKOV PROCESSES IN CONTROL SYSTEMS, by R. P. Wishner. June 1960, 101p. incl. illus. table, refs. (Rept. no. R-116) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-85122) AD 238058 Unclassified

The theory of Brownian motion is shown to be applicable for solving probability densities in a class of nonlinear control systems when the disturbance input is white noise with a Gaussian probability density function. First-order nonlinear systems for the case of zero input signal are treated. The Fokker-Planck equation whose solution is the transition probability density of the error signal in a nonlinear feedback control system is formulated. Analytical solutions are given for the case in which the compensating elements form a quantizer. The case for which the error detector saturates is shown to involve applying the boundary conditions of reflecting barriers to the Fokker-Planck equation. A radar tracking problem is also considered in which the radar system with noise is initially locked on to a target. Using the Fokker-Planck method, the analytical solution to the problem of the probability of losing the target in time t is given. Higher-order systems are also treated. An approximate solution to the probability of loss problem in a second-order system is carried out. A generalization is discussed in which some system, which have non-white noise as their disturbance input, can be treated by the Fokker-Planck method. (Contractor's abstract)

859

Illinois U. Coordinated Science Lab., Urbana.

A METHOD OF ADAPTIVE CONTROL FOR HIGH-ORDER SYSTEMS, by E. A. Huber. Aug. 1960, 79p. incl. illus. refs. (Rept. no. R-121) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA-36-039-sc-85122) AD 243268 Unclassified

A method of adaptive control is developed which is invariant regardless of the complexity of the system under control. The adaptive control system using this method

is a modification of the M.I.T. model-reference system. It is assumed that the type of input signal is known and that it is a pulse or step function. The desired state of the system under control is specified by the appropriate locations of its poles and zeros. Two identical cut-off networks are used whose impulse responses have minimum variance about the time of the maximum. One of these pulse-like outputs is used as a reference for error measurements. The other output is shown to be dispersed when the transfer function of the control system does not meet the specifications. The delay time and width of the response are used as measures of the dispersion, and the necessary adjustments are found from the evaluation of these 2 error measurements. The method is applied to a practical pitch-rate control system which is essentially a fourth-order system. In an experimental test of the theory, 12 applications of the input signal were required to set all 4 poles within a small specified area of the plane from extreme initial positions. (Contractor's abstract)

860

Illinois U. Coordinated Science Lab., Urbana.

THE IDENTIFICATION OF LINEAR PROCESSES BY MEANS OF CORRELATING FILTERS, by W. W. Lichtenberger. Dec. 1960, 81p. incl. diagr. (Rept. no. R-122) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA-36-039-sc-85122) Unclassified

A method of determining the impulse response of a linear system with a correlating filter is applied to process identification for adaptive control. Requirements on the filter characteristics arising from this application are discussed. To reduce the noise at the output of the filter, a method is proposed in which a number of tests are made in succession and the results of the tests are added together by a recirculating delay line or similar device. Optimum design of the correlating filter and a test signal necessary in the scheme are determined on the basis of minimum mean-square error of the estimate. The optimization of the number of tests included in a single measurement is described. The general results are applied to two examples. First, a known, slowly time-varying process is measured. Optimum design is given for this case, and curves showing the optimum number of tests for a special mode of time variation are included. Secondly, the problem of measuring a member of an ensemble of fixed processes is treated. The results of a digital computer simulation are given. Another method of reducing output noise makes use of a constantly revised reference model. It is shown that this method is usually superior to the coherent integration scheme, but that the reference model does not always converge to the correct state. Results of a digital computer simulation showing both good and poor convergence are given. Finally, extensions to the multi-input, multi-output case together with some attendant complications are discussed. (Contractor's abstract)

861

Illinois U. Coordinated Science Lab., Urbana.

ON THE IDENTIFICATION OF LINEAR PROCESSES, by W. W. Lichtenberger. [1959] [2]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA-36-039-sc-85122]) Unclassified

Published in I.R.E. Transactions on Circuit Theory, v. CT-7: 78-79, Mar. 1960.

A technique has been developed which measures the impulse response of a linear process while the process is in operation, without disturbing the output appreciably. Instead of using Lee's method of injecting white noise (n(t)) into the process, a particular signal (r(t)) is injected. A matched filter is then constructed whose impulse response is $r(t_o-t)$. The output of the matched filter will be described by: $z(t) = \int_{-\infty}^{\infty} R_{sn}(\tau)h(t-t_o-\tau)d\tau + \int_{-\infty}^{\infty} R_n(\tau)h(t-t_o-\tau)d\tau$ where $R_{sn}(\tau)$ is the cross-correlation of s(t) with n(t), $R_n(\tau)$ is the autocorrelation of n(t), and t_o is an arbitrary time delay. In the above equation n is replaced by r. If r(t) is of such a nature that its autocorrelation is a sharply peaked impulse-like function and it has little correlation with the signal s(t), then the output of the matched filter is $h(t-t_o)$, a continuous function of real time.

862

Illinois U. Coordinated Science Lab., Urbana.

SOME RECENT EXPERIMENTAL TESTS OF THE "CLOCK PARADOX", by C. W. Sherwin. [1960] [5]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA-36-039-sc-85122]) Unclassified

Published in Phys. Rev., v. 120: 17-21, Oct. 1, 1960.

Recent experiments by Pound and Rebka on the temperature of the Mössbauer effect in Fe^{57}, and by Hay et al. using an Fe^{57} absorber on a rotating drum are shown to provide the first direct experimental verification of the time-keeping properties of accelerated clocks such as occur in the classic "clock paradox" of relativity. In the experiment by Pound and Rebka, the thermal vibrations of the lattice impart rms velocities of about $10^{-6}c$, and nearly continuous, randomly-oriented accelerations of the order of $10^{16}g$ to both the source and the absorber nuclei. In the experiment by Hay et al. the acceleration of the absorber was $6 \times 10^{4}g$. The photon provides continuous communication of time data between the two nuclei for the duration of the "journey"

(the emission time of the quantum). In each case the observed fractional frequency shift $\Delta f/f_0$ which occurs between the source and absorber is found to be $-v_s^2/2c^2 + v_a^2/2c^2$, where v_s and v_a are the rms velocities of the source and the absorber nuclei, respectively. These results are in quantitative agreement with the generally accepted calculations for the "clock paradox", in which two clocks pursue independent paths (at least one of which involves accelerations) in a common inertial frame, but are compared at two or more points where they coincide in space and time. The temperature-dependent experiments also demonstrate the accelerations of the order of 10^{16} g, arising from lattice vibrations, produce no intrinsic frequency shift in Fe^{57} nuclei to an accuracy exceeding 1 part in 10^{13}. (Contractor's abstract)

863

Illinois U. [Dept. of Chemistry] Urbana.

OBSERVATIONS ON THE RARE EARTHS. LXXI. CHEMICAL AND ELECTROCHEMICAL STUDIES OF IODIDE SYSTEMS IN ANHYDROUS N:N'-DIMETHYLFORMAMIDE, by T. Moeller and V. Galasyn. [1959] [7]p. incl. diagrs. tables, refs. (AF 18(600)1535) Unclassified

Published in Jour. Inorg. and Nuclear Chem., v. 12: 259-265, Feb. 1960.

Solvated rare-earth metal iodides having the general formula $LnI_3 \cdot 8DMF$ (Ln = La, Pr, Nd, Sm, or Gd; DMF = N:N'-dimethylformamide) were prepared by reaction of the hydrated acetate with acetyl iodide in dimethylformamide or by metathesis between the anhydrous chloride and potassium iodide in the same solvent. Several properties of the crystalline salts were determined. The solvates dissolve readily in N:N'-dimethylformamide, giving solutions exhibiting weak electrolyte behavior. Such solutions yield amalgams on electrolysis, but conclusive evidence for the deposition of the metals on solid cathodes were not obtained.

864

Illinois U. [Dept. of Chemistry] Urbana.

OBSERVATIONS ON THE RARE EARTHS. LXXII. THE PREPARATION AND CHARACTERIZATION OF ANHYDROUS AND N,N-DIMETHYLFORMAMIDE-SOLVATED ACETATES, by T. Moeller, V. Galasyn, and J. Xavier. [1960] [6]p. incl. tables, refs. (AF 18-(600)1535) Unclassified

Published in Jour. Inorg. and Nuclear Chem., v. 15: 259-264, Oct. 1960.

Rare-earth metal and yttrium acetates were effectively dehydrated by treatment with N,N-dimethylformamide and benzene, followed by azeotropic distillation. Ansolvous acetates, $Ln(C_2H_3O_2)_3$, were obtained where Ln = Y, La, Dy, Ho, Er, and Yb; but where Ln = Ce(III), Pr, Nd, Sm, Eu, or Gd, monosolvated acetates, $Ln(C_2H_3O_2)_3 \cdot DMF$, resulted. The latter compounds readily converted to the ansolvous materials by heating in vacuo at 210°C. Ansolvous and dimethylformamide-solvated acetates were characterized by means of analysis, x-ray diffraction, and infra-red measurements. (Contractor's abstract)

865

Illinois U. Dept. of Chemistry, Urbana.

AUTOMATIC DERIVATIVE SPECTROPHOTOMETRIC TITRATION OF EXCESS EDTA IN THE DETERMINATION OF COBALT, COPPER OR IRON, by H. V. Malmstadt and T. P. Hadjiioannou. [1960] [6]p. incl. diagrs. table. (AFOSR-TN-60-155) (AF 18(603)137) Unclassified

Also published in Anal. Chim. Acta., v. 23: 288-293, 1960.

The metalfluorechromic indicator Calcein W is used as an absorption indicator at 500 mμ for the automatic titration of excess EDTA with copper titrant in the Spectro-Electro derivative titrator. Copper, iron or cobalt are determined by adding a small excess of standard EDTA, as visually indicated in the titrator by fluorescence of Calcein W, with the subsequent automatic titration of excess EDTA. The intense colors of the EDTA complexes of these cations do not cause any difficulty by the automatic spectrophotometric method, and macro as well as micro quantities of the metals can be determined with relative errors of 0.1% or less. It can be seen from diagrams of the titration curves that at 500 mμ the difference in absorbance between the absorbing species present at the beginning of the back-titration and those present at the automatic end-point s about the same, 0.14 of an absorbance unit for about 13 mg of copper, iron or cobalt in a volume of 60 ml. The relative change in absorbance becomes smaller as the concentration of metal increases, because the EDTA complexes of copper, iron, and cobalt also absorb somewhat at 500 mμ. It is also seen that the change in voltage output for iron and cobalt decreases as the amount of metal titrated increases.

866

Illinois U. Dept. of Clinical Science, Chicago.

EFFECT OF STEARIC ACID AND CHOLESTEROL ON BIOSYNTHESIS OF STEROL BY THE CHICKEN LIVER, by T. M. Lin, E. Karvinen, and A. C. Ivy. [1958] [4]p. incl. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)242 and Public Health Service) Unclassified

Published in Amer. Jour. Physiol., v. 198: 29-32, Jan. 1960.

The liver of the chicken synthesizes cholesterol from C^{14}-I-acetate. Stearic acid fed to chickens at a 10% level by weight in the diet was associated with a significant increase in the rate of hepatic cholesterol synthesis above that of the control group. Neither present observations nor those in the literature on other species reveal whether the observed augmentation was due to the saturation of the stearic acid. The feeding of cholesterol at a level of 2.5% by weight of the diet decidely inhibited the hepatic synthesis of cholesterol whether 10% stearic acid was present in (76% inhibition) or absent from the diet (78% inhibition). A relatively large (23%) hepatic synthesis of cholesterol occurred when the diet contained more cholesterol than could be absorbed under the condition of this experiment. (Contractor's abstract)

867

Illinois U. [Dept. of Mathematics, Urbana].

ON WEIERSTRASS PRODUCTS OF ZERO TYPE ON THE REAL AXIS, by J. P. Kahane and L. A. Rubel. July 15, 1960, 13p. (AFOSR-TN-60-807) (AF 49(638)-517) AD 245673; PB 152972 Unclassified

Also published in Illinois Jour. Math., v. 4: 584-592, Dec. 1960.

Under the well-known restriction $\int_{-\infty}^{\infty} (1 + r^2)^{-1} \log^+ |f(r)| dr < \infty$ on the rate of growth on the real axis of entire functions of exponential type, the type of a product is the sum of the types of the factors. It is shown here that this is no longer true if these restrictions are relaxed. As a consequence, the theorem of supports for certain generalized distributions falls to hold. (Contractor's abstract)

868

Illinois U. [Dept. of Mathematics, Urbana].

THE ZEROS OF ENTIRE FUNCTIONS OF EXPONENTIAL TYPE, by P. Malliavin and L. A. Rubel. Aug. 5, 1960 [40]p. incl. refs. (AFOSR-TN-60-910) (AF 49-(638)517) AD 243162 Unclassified

The following theorem is proved: in order that there exist a non-null entire function f(z) of exponential type that vanishes on a given sequence $\lambda_0, \lambda_1, \lambda_2, \ldots$ of positive real numbers and satisfies $|f(iy)| < \exp(\pi b|y|)$ for all real y, it is necessary and sufficient that there exist a constant K such that if $x \leq y$ then $\lambda(y) - \lambda(x) \leq \log(y/x) + K$, where $\lambda(x)$ is the sum of the reciprocals of those λ_n that do not exceed x. (Contractor's abstract)

869

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

ANELASTIC MEASUREMENTS OF DIFFUSION COEFFICIENTS, by J. Stanley and C. West. Mar. 25, 1960 [42]p. incl. diagrs. tables, refs. (AFOSR-TN-60-203) (AF 18(603)22) AD 235947 Unclassified

A discussion is presented on anelastic measurements of metals and alloys in terms of detailed atomic motion and on calculations of diffusion coefficients for them. The correlation between anelastic measurements and diffusion can be seen if the coefficient of diffusion, D, is written in the form $D = K\frac{\alpha 2}{\tau}$, where α is the lattice parameter, τ is the mean time between successive jumps of a given atom, and K is a geometrical constant. The term, anelastic solid, is used to specify those solids whose behavior obeys a homogeneous, linear differential equation in stress, strain, and their first time derivatives. Constants in this equation may be written $\sigma + \tau_\epsilon \dot{\sigma} = M_R(\epsilon + \tau_0 \dot{\epsilon})$, where σ and ϵ are the stress and strain, respectively, and τ_ϵ, τ_0, and M_R are all constants of the material. Two solutions are discussed, one for the case where $\dot{\sigma} = 0$ and the other, the general solution. A new set of measurements is reported for the Fe-V alloy system in an attempt to determine a relationship between relaxation time and D for a simple solid solution alloy with bcc structure. Diffusion measurements with radioactive isotopes indicated that ferromagnetic ordering of spins which occurs below the Curie temperature (840°C) greatly retards diffusion.

870

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

AN INVESTIGATION OF THE USE OF INTERNAL FRICTION TECHNIQUES IN THE STUDY OF DIFFUSION AND PHASE CHANGES IN METALS, by J. Cost and C. Wert. Final rept. May 15, 1960 [33]p. incl. diagrs. (AFOSR-TR-60-83) (AF 18(603)22) Unclassified

The six topics investigated under this contract are reviewed individually. The studies of phase separation in Au-Ni alloys are reportedly not being continued at this time. The results are concerned with describing the precipitation phenomena which apparently must involve atomic rearrangements in the alloy. The studies on alloys of Cd with Mg have shown that the crystal structure has a damping effect. Additional experiments and measurements on this crystal were also done because the crystal showed several ordering compositions. The effect of ferromagnetism on diffusion is also discussed although the reason for the existence of the anomalous effect that is observed is not determined. The studies on niobium, tantalum, and vanadium and the degree of purity they can achieve in their equilibrium

with oxygen and nitrogen as a function of the pressure and temperature are also reviewed. Three different systems were studied to help determine these facts. The final section deals with the internal friction of Hf. Preliminary results indicate that a damping effect can be observed in oxidized samples.

871

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

ON THE DETERMINATION OF DIFFUSION COEFFICIENTS IN CHEMICAL DIFFUSION, by R. W. Balluffi. Feb. 11, 1960 [10]p. incl. refs. (AFOSR-TN-60-239) (AF 18(603)106) AD 234188; PB 146444 Unclassified

Also published in Acta Metall., v. 8: 871-873, Dec. 1960.

The equations describing chemical diffusion in the general case where the partial molal volumes of the diffusing components may differ and may vary with composition are reviewed and discussed. Exact and easily applied relations for obtaining chemical and intrinsic diffusivities are derived. The results should replace the standard Darken equations and Boltzmann-Matano analysis whenever there is any possibility that differences and variations of the partial molal volumes are of significance. (Contractor's abstract)

872

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

RESEARCH ON DIFFUSION AND IMPERFECTIONS IN METALS, by R. W. Balluffi. Final rept. Aug. 30, 1960, 11p. (AFOSR-TR-60-130) (AF 18(603)106) AD 245088 Unclassified

The research concentrated on various aspects of chemical and self-diffusion and the role of crystal imperfections in these processes. Specific investigations include: (1) structural changes in the diffusion zone during chemical diffusion; (2) the effect of non-equilibrium vacancies on the kinetics of Kirkendall diffusion; (3) the Kirkendall effect in the hexagonal close-packed phase of cadmium and mercury; (4) the effect of simultaneous plastic deformation on self-diffusion in silver; (5) the effect of a steady rate of plastic deformation on chemical diffusion in copper-zinc alloys; (6) relative polygonization rates in a number of close-packed metals and alloys; and (7) the determination of diffusion coefficients in chemical diffusion. (Contractor's abstract)

873

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

THERMOELECTRIC PROPERTIES OF MAGNESIUM TITANATES, by S. M. Myron. Nov. 10, 1960, 63p. incl. tables, refs. (AFOSR-TN-60-1188) (AF 49(638)212) AD 248554; PB 153836 Unclassified

Sintered disc-shaped samples of 3 magnesium titanates were partially reduced by heat treatment in hydrogen. The values of electrical resistivity, thermoelectric coefficients, and donor concentration were determined in dependence both of degree of reduction and of temperature. Linear logarithmic relations were established between these quantities. Moderately large thermoelectric coefficients were found but the correlated electrical resistivities were too high for technical applications of these materials for power generation or for refrigeration. (Contractor's abstract)

874

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

SCREW DISLOCATIONS IN CRYSTALS WITH DIAMOND STRUCTURE, by V. Celli. [1960] [9]p. incl. diagrs. (AFOSR-TN-60-388) (AF 49(638)420) AD 258909 Unclassified

Also published in Jour. Phys. Chem. Solids, v. 19: 100-104, 1961.

The model of dislocation in a lattice recently proposed by Maradudin (MDU.02:021, Vol. II) is modified and applied to an estimate of the strain energy of a screw dislocation in crystals with the diamond surface structure, in particular Si and Ge. The most probable configuration for the screw dislocation is indicated and it is shown that only displacements in the [110] direction are allowed. The final expression for E, in 2 examples, is derived and is formally the same as Maradudin's expression. It is, thus, shown that the model of Maradudin is likely to be better suited to discuss dislocations in crystals with the diamond structure.

875

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

KINETIC THEORY OF DISLOCATION CLIMB, by R. Thomson. Apr. 11, 1960, 30p. incl. illus. (AFOSR-TN-60-389) (AF 49(638)420) AD 253741 Unclassified

The kinetic theory of the condensation and evaporation of vacancies and extra atoms from edge dislocations is treated. The formalism developed yields the jog density on a dislocation in equilibrium in terms of the jog energy. A set of equations is developed to describe steady state dislocation climb. The solution of the steady state climb is discussed under various physical conditions such as rapid and slow climb with high and low vacancy supersaturations. The climb rate for low supersaturation is very simple and is proportional to the length of the dislocation, vacancy mobility and a Boltzmann factor with the jog pair energy. The slow climb equations can

be applied to platelet growth and yield an initial exponential growth followed by quadratic growth. The climb of a screw dislocation is discussed more briefly in terms of the glide mobility of vacancy aggregates along the dislocation and the climb of spiral platelets. (Contractor's abstract)

876

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

ON THE CRYSTALLOGRAPHY OF MARTENSITE: THE "{225}" TRANSFORMATION IN ALLOYS OF IRON, by C. M. Wayman, J. E. Hanafee, and T. A. Read. [1960] [30]p. incl. illus. diagrs. refs. (AFOSR-TN-60-525) (AF 49(638)420) AD 239362; PB 148874 Unclassified

Also published in Acta Metall., v. 9: 391-402, May 1961.

For an accurate study of the martensite transformation in iron alloys it is necessary that the lattice orientation relationship be obtained from a single plate of martensite whose habit plane direction cosines are already known. Heretofore, such observations have not been made for the $\{225\}_A$ type martensite in iron alloys, but such an analysis is reported herein for an alloy, Fe-7.90 wt-% Cr-1.11 wt-% C, for which a habit plane approximately described by $\{449\}_A$ was observed. The theories of Bowles-Mackenzie, and Wechsler-Lieberman-Read, which differ in the interpretation of the {225} transformation, were examined with these new experimental results. The WLR theory is in substantial agreement with the results, provided that the lattice invariant shear is assumed on the {011} plane of the martensite. The BM theory, allowing an isotropic interface dilation, provides an equally good description if the shear occurs on a $\{112\}_M$ plane. In each case, the predicted shear direction is near the expected close-packed $\langle 111\rangle_M$ direction. Some microscopic observations suggest that the interface plane may not be one of zero net distortion, as supposed by WLR, and that a dilation in the interface appears reasonable. The significance of observed martensite side plates is discussed. (Contractor's abstract)

877

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

DRAG ON A MOVING DISLOCATION IN THE FRENKEL-KONTOROVA MODEL, by R. Hobart. June 29, 1960, 23p. incl. diagrs. refs. (AFOSR-TN-60-923) (AF 49-(638)420) AD 253827 Unclassified

In discussing models for plastic deformation based on the movement of dislocations, it is of interest to know what processes control the motion of the individual dislocations under a given set of circumstances. Although several possible controlling mechanisms have been discussed in the literature, this paper is concerned with the drag due to elastic waves emanating from the core resulting from periodic changes in the core as the dislocation moves from one equivalent lattice position to the next. A modified Frenkel-Kontorova model is used in the hopes that study of a simplified model will facilitate the developing of techniques which will give insight into the motion of dislocations in more complicated models.

878

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

PIPE DIFFUSION IN LITHIUMFLUORIDE, by A. L. Laskar and R. Tucker. July 29, 1960, 65p. incl. illus. diagrs. tables, refs. (AFOSR-TN-60-1116) (AF 49(638)-420) AD 254027 Unclassified

Presented at ...ting of the Amer. Phys. Soc., Monterey, Calif., Mar. 20-23, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 131, Mar. 20, 1961.

A study was made of the diffusion and conductivity characteristics along single or a small group of dislocations; an attempt was made to understand the atomic mechanism responsible for such behavior. When a microprobe electrode with a negative potential was placed on the top surface of an LiF crystal on dislocation etchpits, the lower side of the crystal being plated with NaCl, both enhanced conductivity through the crystal and the deposition of a metallic-like material on the top surface near the probe. Normally, the progress of current with time showed a sharp rise followed by a gradual decay to a saturation level which remained constant for the rest of the run. In the lower temperature and voltage ranges, the time required to reach the peak current was higher by at least 1 to 2 orders of magnitude and showed a plateau instead of a smooth decay. A temperature cut-off for current was observed at nearly 250°C. Microscopic scrutiny during the progress of the experiments showed a build-up of material around the probe. Interconnected dendrites, platelet formations, and their extensions also were noted within the bulk of the crystal. Pulses in the current records were observed to be coincident with sudden appearance of dendrites and platelets of material. The total charge calculated from the radioactivity of the material deposited in the vicinity of the probe corresponded within small scatter to the total charge calculated from the I-t plot up to peak for high temperature runs, and the same up to the end of the plateau for low temperature runs.

879

Illinois U. [Dept. of Mining and Metallurgical Engineering] Urbana.

THE PROPERTIES OF DISLOCATIONS IN CRYSTALS, by R. Thomson. Final rept. Sept. 15, 1960, 15p. incl. diagrs. (AFOSR-TR-60-141) (AF 49(638)420) AD 251103; PB 154713 Unclassified

The work under this contract has been both theoretical and experimental. The former studies have worked out the rate with which vacancies can be absorbed or created in the crystal from the dislocation core, and investigated the details of how the core of the dislocation behaves when the dislocation moves from one place in the crystal to another. The first phenomenon is important when a crystal has to absorb excess vacancies or create them when the ambient temperature of the crystal is suddenly changed. The second process is important for a basic understanding of the processes of plasticity, where dislocation movement is a necessary assumption. Experimental studies were carried out on diffusion of atoms along the core, and on dislocation mobility under stress. The diffusion along dislocations is thought to be very fast, but the basic process is little understood. It is an important diffusion mechanism in certain temperature and composition ranges. The mobility studies complement the theoretical study of dislocation dynamics. (Contractor's abstract)

880

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

DIFFUSION IN A FERROMAGNETIC ALLOY, by J. Stanley and C. Wert. June 7, 1060 [25]p. incl. diagrs. (AFOSR-TN-60-883) (AF 49(638)672) AD 243916 Unclassified

Also published in Jour. Appl. Phys., v. 32: 267-273, Feb. 1961.

Diffusion constants in an alloy of Fe + 18%V have been determined over a wide temperature range by a combination of radioactive tracer and anelastic methods. The region of measurement extends over a considerable interval on both sides of the magnetic Curie temperature. The data show a pronounced effect of ferromagnetic spin-ordering on diffusion. Diffusion in the well ordered ferromagnetic state is about 100 times slower than would be expected from extrapolation of data in the paramagnetic region. Part of this retardation appears to be an increase in the activation energy and part a decrease in D_0. (Contractor's abstract)

881

Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana.

SELF-DIFFUSION IN SILVER DURING PLASTIC DEFORMATION IN TORSION, by J. B. Darby, Jr., C. T. Tomizuka, and R. W. Balluffi. Dec. 20, 1960 [33]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1394) (AF 49(638)880) AD 248732; PB 153839 Unclassified

Also published in Jour. Appl. Phys., v. 32: 840-848, May 1961.

Self-diffusion of Ag^{110} in silver polycrystals subjected to simultaneous torsion was studied at 700° and 800°C using the sectioning technique. Strains ≤ 0.50 and strain rates $\leq 13.8 \times 10^{-5}$ sec^{-1} were employed. Specimen structures before and after deformation were also examined. The effects of straining on diffusion were relatively small in all cases. At 800°C the diffusivity was increased by no more than ~50%. At 700°C the increase was no more than ~100%. A substantial part of this observed enhancement may have been only apparent and due to difficulties associated with surface roughness. The results agreed generally with our previous work involving deformation in extension and compression but were in marked disagreement with recent results of Lee and Maddin and Forestieri and Girifalco who have reported enhancements larger by one to two orders of magnitude. No simple explanation for these differences was found. Calculations of dislocation short-circuiting and the generation of extra point defects indicated that only small enhancements should be expected, in agreement with the present results. (Contractor's abstract)

882

Illinois U. [Dept. of Physics] Urbana.

[ON THE EXCITED SPECTRUM OF ALKALI HALIDES] Über die Excitonenspektren der Alkalihalogenide, by F. Fischer. [1960] [7]p. incl. diagrs. tables. (AFOSR-4287) (AF 18(600)662) Unclassified

Also published in Zeitschr. Phys., v. 160: 194-200, 1960.

It can be shown from the exciton spectrum of the alkali halides that the ^{2}P-function of the alkali atom seems to be necessary, if it is desired to construct certain excitons by means of atomic orbital functions. A relation between the ionization energy of the exciton and the orbital dielectric constant was obtained from the experiments. This result is consistent with a hydrogenic model of the exciton.

883

Illinois U. [Dept. of Physics] Urbana.

NUCLEAR RESONANCE ABSORPTION AND NUCLEAR ZEEMAN EFFECT Fe^{57}, by O. DePasquali, H. Frauenfelder and others. [1960] [11]p. incl. diagrs. refs. (AFOSR-TN-60-5) (AF 18(603)49) Unclassified

Also published in Phys. Rev. Ltrs., v. 4: 71-73, Jan. 16, 1960.

The resonance absorption in Fe^{57} following an expansion and modification of Mössbauer's procedure is discussed. Experiments may be carried out at temperatures up to 200°C due to the low recoil energy of the 14.4 kev photon and the high Debye temperature of iron. When resonance absorption is shown as a function of temperature, the curve remains essentially constant from 25 - 200°C, begins to decrease slowly, and approaches zero asymptotically at about 550°C. Resonance absorption is shown as a function of absorber thickness. Zeeman splitting of the 14.4 kev transition is demonstrated in graphic form and from this the value of f and f' (the probability of absorption without recoil) are found to be 0.20 ± 0.04 and 0.22 ± 0.06 respectively. It was found that the measured value for the width of the central line was larger than expected. This discrepancy may be due either to a small state or to extranuclear interactions.

884

Illinois U. Dept. of Physics, Urbana.

MÖSSBAUER EFFECT. RECOILLESS EMISSION AND ABSORPTION OF GAMMA RAYS; A Conference, Illinois U., June 6-7, 1960, ed. by H. Frauenfelder and H. Lustig. [1960] 76p. incl. diagrs. tables, refs. (AFOSR-TN-60-698) (AF 18(603)49) AD 240109; PB 149301 Unclassified

The following topics were discussed in an informal meeting on Mössbauer effect (recoilless emission and absorption of gamma rays): theory, isotopes, experimental, relativity, nuclear applications, chemical shifts, line width, internal fields, impurities, resonance experiments and ultrasonics, and Rayleigh scattering and varia.

885

Illinois U. [Dept. of Physics] Urbana.

SEARCH FOR THE ANISOTROPY OF INERTIA USING THE MÖSSBAUER EFFECT IN Fe^{57}, by C. W. Sherwin, H. Frauenfelder and others. [1960] [3]p. incl. diagr. (AFOSR-3552) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)49], Atomic Energy Commission, Office of Naval Research, and Signal Corps) Unclassified

Also published in Phys. Rev. Ltrs., v. 4: 399-401, Apr. 15, 1960.

The width of the central resonance absorption line in the Mössbauer effect in Fe^{57} has been found by many observers to be considerably greater than the natural linewidth. Experiments were designed to determine if the effects were due to the Galaxy. The first test shows that there is no significant change in the linewidth between the conditions of the test. A more sensitive test, designed to overcome the limitations which arise because the local magnetic fields at the nuclei in the source and absorber are different and produce a broadening effect, were conducted. These tests also show that no effects are caused by the Galaxy, although the results are open to different interpretations.

886

Illinois U. [Dept. of Physics] Urbana.

PHOTOPRODUCTION OF H CENTERS AT 15°K, by J. [D.] Kingsley. May 1960 [5]p. incl. diagr. (Technical note no. 1) (AFOSR-TN-60-634) (AF 49(638)529) AD 238745; PB 148772 Unclassified

Crystals of KBr and KCl were exposed to the unfiltered radiation from a quartz mercury lamp at temperatures near 15°K in a direct test of the necessity of the Varley mechanism. An absorption band peaking at 381 mμ, and F band, and a number of other bands were formed. The half-width and shape of the 381 mμ band were the same as those of the H band. The absorption in this wavelength region decreased, and the band changed its shape at 36°, 46°, 78°, and 110°K when the crystal was warmed. The behavior of the band produced by this mercury arc radiation was similar to that of the 381 mμ band produced by irradiation with x-rays, with slight differences, probably due to differences in concentrations and types of centers produced by the two kinds of radiation. The initial growth rate of the 381 mμ absorption band in KBr was larger for those crystals having the larger OH^- ion concentration. It seems that the presence of the hydorxyl ion impurity can catalyze the formation of interstitial halogen atoms in KBr and KCl by an unknown mechanism and that the Varley mechanism is not necessary for the production of H centers in these crystals.

887

Illinois U. [Dept. of Physics] Urbana.

COLOR CENTER REACTIONS IN THE ALKALI HALIDES, by J. [D.] Kingsley. June 1960 [122]p. incl. diagrs. refs. (Technical note no. 2) (AFOSR-TN-60-635) (AF 49(638)529) AD 239417; PB 148971 Unclassified

Experiments were directed toward the photoconductive bleaching and restoration properties of the V_4 center and toward the processes involving the destruction of V_1 centers; most of the experiments were performed on KBr. No evidence for photoconductive response due to the presence of V_4 centers was found; the sole contributor to the UV photoresponse appeared to be the F center. The bleaching and restoration properties of the V_4 band were considered to be a consequence of the symmetry of the V_4 center being lower than cubic. An investigation of the electron capture cross sections of the

V centers indicated that, with the exception of the V_K center, the V centers, in particular the V_1 center, have very small cross sections. Annihilation of V_1 centers through either thermal or optical excitation suggests that V_1 and F centers can recombine to form a perfect lattice and the production or destruction of no other detectable defects in the solid. The most probable model of the V_1 center which is consistent with its known properties is a halogen-molecule-ion lying along a (111) axis in a halogen ion vacancy. The following anomalies with current accompanied thermal destruction of V_1 centers: (1) the current does not achieve maximum value at the same temperature that the centers are disappearing most rapidly; and (2) through optical bleaching prior to thermal destruction of the V_1 centers, the current could be reduced without apparent effect on the behavior of the V_1 centers. Interstitial defects in alkali halides formed by UV irradiation were demonstrated.

888

Illinois U. Dept. of Physics, Urbana.

PHOTOCHEMISTRY OF THE V_1 CENTER, by J. D. Kingsley. [Dec. 1960] [7]p. incl. diagrs. refs. (AFOSR-4252) (AF 49(638)529) Unclassified

Also published in Phys. Rev., v. 122: 772-778, May 1, 1961.

A series of photochemical experiments on the color centers present in KBr and KCl after exposure to x-rays at 80°K is discussed. These experiments are chemical in nature with the reactions being triggered through exposure to radiation of various wavelengths. It is shown that the only V center which has a large electron capture cross section is the V_K center and the cross section of the V_1 center is very small. It is also known that the destruction of the V_1 center does not involve the annihilation of an electron or hole trapped at a crystal imperfection but apparently involves the addition of an interstitial to the F center, yielding as a product the undisturbed lattice. The implications of these observations as they relate to the structure of the V_1 center are discussed. (Contractor's abstract)

889

Illinois U. [Dept. of Physics] Urbana.

ELECTRON MOBILITY AND SCATTERING PROCESSES IN AgBr AT LOW TEMPERATURES, by D. C. Burnham, F. C. Brown, and R. S. Knox. Mar. 1960 [47]p. incl. diagrs. tables, refs. (Technical note no. 3) (AFOSR-TN-60-419) (AF 49(638)579) AD 236162; PB 146930 Unclassified

Also published in Phys. Rev., v. 119: 1560-1570, Sept. 1, 1960.

The Hall effect for electrons released by light in high-purity crystals of AgBr has been studied experimentally in the temperature range 4° to 120°K. The observed mobilities exceed 20,000 cm^2/volt-sec at very low temperatures. The general features of the dependence of low-field Hall mobility on temperature can be understood by comparison with standard theory. A nearly exponential dependence of mobility on 1/T is observed from 40° to 120°K, as predicted for scattering by optical vibrations of the lattice. The slope of the log μ versus 1/T data agrees quite well with the DebyeΘ for the longitudinal optical mode as deduced from Reststrahl data. Below 40°K the observed mobilities can be explained in terms of a combination of the effects of optical, acoustical and charged impurity scattering. The last process appears to dominate below 15°K. High-field effects are observed which can be explained by classical transport theory assuming a conduction band of standard form as well as isotropic scattering. (Contractor's abstract)

890

Illinois U. Dept. of Physics, Urbana.

HALL MOBILITY OF HOLES IN SILVER BROMIDE, by R. C. Hanson. June 1960, 72p. incl. diagrs. tables, refs. (Technical note no. 4) (AFOSR-TN-60-795) (AF 49-(638)579) AD 240108; PB 149438 Unclassified

Hall mobility measurements were made on holes introduced into AgBr by a bromine atmosphere in the temperature range from room temperature to 150°C. These measurements were made using conventional electrode geometry and sensitive high impedance a-c techniques similar to those used by Macdonald and Robinson. The Hall mobility for holes varied from 2.0 ± 0.5 cm^2/volt-sec at room temperature (27°C) to 0.5 ± 0.15 cm^2/volt-sec at 150°C. The hole mobility was found to be about 30 times smaller than the electron mobility determined by other workers at room temperature. The temperature dependence of the hole mobility is about T^{-4}. This is much steeper than the temperature dependence of the electron mobility in this region. Preliminary measurements were also made on the thermoelectric power of AgBr in a bromine atmosphere. If the classical theory used is correct, these measurements indicate that the density of states effective mass for the holes is very small. (Contractor's abstract)

891

Illinois U. of Physics, Urbana.

LOW TEMPERATURE PHOTOCONDUCTIVITY OF ADDITIVELY COLORED KCl, by R. L. Wild, F. C. Brown, and N. Inchauspé. Aug. 1960 [36]p. incl. diagrs. tables, refs. (Technical note no. 5) (AFOSR TN-60-1117) (AF 49(638)579) AD 245540 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 281, Apr. 24, 1961.

Also published in Phys. Rev., v. 121: 1296-1302, Mar. 1, 1961.

The transient photoconductivity of additively colored crystals of KCl has been investigated at temperatures down to 10°K. The spectral response reflects the structure in optical absorption in the ultraviolet reported by Lüty. Quantum yields are found to be less than 1.0 at 10°K but are much higher in the region of the L_1 (3.6 ev) and L_2 (4.2 ev) bands than in the K band on the high-energy side of the F band. The beginning of electron collection or saturation effects was found in the case of thin, lightly colored crystals which indicates that electron ranges were in the vicinity of 10^{-6} cm^2/volt at 10°K. Shallow traps effective below 26°K were found in the crystals studied so far. These traps have a large product of concentration times cross section and compete favorably with the F center at 10°K. They can be partly filled following illumination at low temperature with the result that enhanced photoresponse is produced in the red and near infrared. (Contractor's abstract)

892

Illinois U. [Dept. of Physics] Urbana.

ELECTRON MOBILITY AND SCATTERING IN POLAR CRYSTALS AT LOW TEMPERATURES, by F. C. Brown. [1960] [3]p. incl. diagr. (AFOSR-3995) [AF 49(638)579] Unclassified

Published in Proc. Internat'l. Conf. on Semiconductor Physics, Prague (Czechoslovakia) (Aug. 29-Sept. 2, 1960), Prague, Publishing House of the Czechoslovak Academy of Sciences, 1961, p. 675-677.

The Hall mobility of electrons released into the conduction band by light was studied as a function of temperature down to 4°K in single crystals of AgCl, AgBr, and in KCl containing F centers. The results in the case of the silver halides can be explained by optical mode scattering above about 30°K and by a combination of scattering mechanisms at very low temperatures. (Contractor's abstract)

893

Illinois U. [Dept. of Physics] Urbana.

PHOTOELECTRIC HALL EFFECT IN KCl AT LOW TEMPERATURES, by F. C. Brown and N. Inchauspé. [1960] [3]p. incl. diagr. refs. (AFOSR-3997) (AF 49-(638)579) Unclassified

Also published in Phys. Rev., v. 121: 1303-1305, Mar. 1, 1961.

The Hall effect for carriers released by light has been studied over a temperature range 4° to 114°K in additively colored crystals of KCl containing various concentrations of F centers. A negative Hall signal was observed corresponding to electrons released from F centers by light absorbed in the high-energy side of the F band. The Hall mobility rises steeply below 80°K due to freezing out of the optical modes of lattice vibration. A residual mobility near 4000 cm^2/vsec is found below 30°K in the crystals prepared so far. (Contractor's abstract)

894

Illinois U. Dept. of Physics, Urbana.

INTERACTION OF HIGH-ENERGY PHONONS IN GERMANIUM, by G. Ascarelli. [1960] [3]p. incl. diagrs. refs. (In cooperation with Massachusetts Inst. of Tech., Cambridge) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)579], Office of Naval Research, and Signal Corps) Unclassified

Published in Phys. Rev. Ltrs., v. 5: 367-369, Oct. 15, 1960.

The theoretical explanation of the non-Ohmic conductivity of germanium was that electrons which have been very much accelerated by an applied electric field will emit phonons and lose an appreciable fraction of their energy. This is a report of the observation made of a transport of energy by phonons excited by hot electrons. The apparatus was arranged so that small changes in the properties of the cavity could be easily detected. Frequency shifts of the order of 0.1% were detected. From the observed behavior and by comparisons with the measurements of thermal conductivity, an attempt was made to evaluate an average phonon energy and its mfp.

895

Illinois U. [Dept. of Physics] Urbana.

ZONE REFINING OF SILVER HALIDES, by F. Moser, D. C. Burnham, and H. H. Tipplns. [1960] [8]p. incl. diagrs. tables, refs. (In cooperation with Eastman Kodak Co., Rochester, N. Y.) [AF 49(638)579] Unclassified

Published in Jour. Appl. Phys., v. 32: 48-54, Jan. 1961.

The techniques of zone melting have been applied to AgCl and AgBr in an attempt to obtain large crystals of extremely high purity. By measuring distributions in ingots with deliberate impurity additions, both optimum conditions for zoning and distribution coefficients for several impurities were determined. For AgCl, zone melting in a chlorine atmosphere led to near-ultimate distributions for Cu, Pb, Ni, and Fe after passage of 70 zones at a rate of 3 in./hr. The distribution coefficients determined were as follows: Cu, 0.4; Pb, 0.4; Ni, 1.4; and Fe, 0.7. Zone melting in vacuum resulted in similar distributions for Cu, Pb, and Ni, but Fe separated with an effective distribution coefficient slightly greater than one. Under these conditions, Mn and Cd separated in a direction opposite to that of zone travel, and Sn, Al, and Sr separated in the direction of zone travel. Zone refining of nominally pure AgCl resulted in crystals which probably contain less than one part in 10^9 of Cu and Ni, less than one part in 10^8 of Pb, and less than five parts in 10^8 of Fe. Limited data on AgBr indicate that in this case, too, useful purification can be obtained. The dark electrical conductivity of the zoned crystals was found to be intrinsic above 315°K for AgCl and 300°K for AgBr. (Contractor's abstract)

896

Illinois U. Dept. of Physics, Urbana.

A STUDY OF THE PROPERTIES OF RADIOACTIVE NUCLEI BY OPTICAL ORIENTATION, by R. Novick, M. N. McDermott and others. Final rept. Nov. 1959-July 1960, 4p. (AFOSR-TR-60-82) (AF 49(638)781) AD 243045 Unclassified

During the life of this contract, apparatus was designed and constructed for the determination of the spins and moments of Cd^{107} and Cd^{109}. The technique utilized requires a cadmium spectral lamp, a cadmium scattering bulb, a photo detector, controlled magnetic fields, and suitable polarizing optics. Considerable effort was devoted to the development of intense spectral lamps. It was found that essentially the same light output and spectral distribution could be obtained with the low frequency (20 mc/sec) and microwave excitation (3,000 mc/sec). Both the low and high frequency lamps proved superior in intensity and narrowness of the spectral line to the tested commercial source, an Osram Cd lamp. In connection with the light source study, a simple magnetic scanning technique was developed for determining the energy distribution within a given spectral line. A great deal of effort was expended in finding suitable polarizing materials for the ultraviolet. The most satisfactory solution was the polarizing material furnished by Polacoat, Inc. of Blue Ash, Ohio. A search for material for quarter-wave plates has resulted in the ability to make 2 x 2 in. quarter-wave plates for 3261A. The apparatus for obtaining a cadmium double resonance was tested and resulted in a signal from Zeeman transitions in the 5 $^3P_1$ state for both the even and odd mass number isotopes. The minimum number of atoms was estimated to within a factor of 5 at 5 x 10^{12} atoms, and on this basis an attempt was made to observe a double resonance signal in the radio isotopes, Cd^{107} and Cd^{109}. It was determined that each isotope had 10^{13} atoms.

897

Illinois U. Dept. of Physics, Urbana.

THEORETICAL RESEARCH IN ELEMENT ABUNDANCES AND STELLAR SYNTHESIS OF ELEMENTS. Interim tentative final rept. Oct. 31, 1960, 3p. (Status rept. no. 2) (AFOSR-TR-60-144) (AF 49(638)896) Unclassified

The work under this contract has been the study of the r-process. The method has been to extrapolate a mass formula from the region of stable nuclei to that of the neutron-rich nuclei through which the capture path proceeds. This depended upon the development of a new mass formula containing a coulomb exchange term, additional surface terms arising from the finite skin thickness of the nucleus, and shell and deformation terms. As of this date it appears that considerably more work is necessary for the achievement of such a formula. Work on the first aspect of the contract has resulted in a plausible explanation accounting for the different critical neutron binding energies at 50, 82, and 126 neutrons. It has been shown that for any reasonable choice of mass law, the r-process abundance peak at 50 neutrons must have been synthesized at higher temperature and/or lower neutron flux than obtained for the r-process peaks at 82 and 126 neutrons. It is for the analysis of these two latter peaks that the form of the shell and deformation terms are especially important. The conclusion is, therefore, that two types of supernova, and perhaps three, are required to account for the r-process nuclei found in the solar system.

898

Illinois U. [Dept. of Psychology] Urbana.

THE ORGANIZATION OF COMPONENT RESPONSE ERROR EVENTS IN TWO-DIMENSIONAL VISUAL TRACKING, by J. A. Adams and C. E. Webber. [1960] [13]p. incl. diagrs. tables, refs. (AFOSR-TN-60-136) (AF 49(638)371) AD 258662 Unclassified

Also published in Jour. Exper. Psychol., v. 61: 200-212, Mar. 1961.

Two groups of 15 subjects each were used to test the generality of the independence law which asserts that the time-on-target (TOT) response events of each component task of a multidimensional tracking task are statistically independent of one another. The law was tested as a function of the characteristics of input signals, width of the TOT scoring zone, and amount of practice. Group I had unsystematic input signals and

past research in this area suggested that its data should be describable by the independence law. Group NI had input signals specially designed to induce inapplicability of the law. The independence law fit Group I's TOT measures on all trials and scoring zones. For Group NI, however, substantial discrepancies were found which were a function of practice and width of the scoring zone. (Contractor's abstract, modified)

899

Illinois U. [Dept. of Psychology] Urbana.

SOME DETERMINANTS OF TWO-DIMENSIONAL VISUAL TRACKING BEHAVIOR, by J. A. Adams and L. V. Xhignesse. [1959] [13]p. incl. diagr. tables, refs. (AFOSR-TN-60-1132) (AF 49(638)371) AD 253460 Unclassified

Also published in Jour. Exper. Psychol., v. 60: 391-403, Dec. 1960.

Two values each of stimulus coherency, spatial separation of stimulus sources, and the rate of change of events were investigated. It was conjectured that subject's acquired ability to predict certain events in the high-coherency case would positively influence tracking proficiency by permitting the individual to respond to a source in the absence of direct visual attention, thereby reducing the requirement for visually scanning the sources and responding to all events by direct visual sensing. Findings revealed that tracking proficiency was related positively to the proximity of stimulus sources and inversely to the speed of event change when stimulus coherency was low. However, when coherency was high, only event rate was a differentiating variable. Spatial separation did not distinguish between the groups of any given rate condition, presumably because the individual was utilizing his capability for predicting high coherency events to reduce the demands of visual scanning when stimulus sources were widely separated. (Contractor's abstract)

900

Illinois U. [Dept. of Psychology] Urbana.

ANTICIPATORY TIMING OF CONTINUOUS AND DISCRETE RESPONSES, by J. A. Adams and L. R. Creamer. [1960] [7]p. incl. diagrs. refs. (AFOSR-TN-60-1351) (AF 49(638)371) Unclassified

Also published in Jour. Exper. Psychol., v. 63: 84-90, Jan. 1962.

The hypothesis that anticipation of directional signal change in one-dimensional continuous tracking, and time of event change in discrete tracking, is some function of mediated responses and their response - produced cues was tested. Significant amounts of transfer of training were found and mediation as a mechanism for anticipation in tracking was found tenable. No differences were found for the motor vs nonmotor locus of the mediators. Time varying proprioceptive traces and cognitive learning were considered as explanations for the above phenomena. (Contractor's abstract, modified)

901

Illinois U. [Dept. of Psychology] Urbana.

RESPONSE TO SIMULTANEOUS STIMULATION OF TWO SENSE MODALITIES, by J. A. Adams and R. W. Chambers. [1960] [9]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1447) (AF 49(638)371) Unclassified

Also published in Jour. Exper. Psychol., v. 63: 198-206, Feb. 1962.

The question of whether a human could perform two tasks simultaneously without impairment was tested. A bisensory discrete tracking task was used where a probabilistic series of simultaneous auditory and visual stimuli were presented, each stimulus series for response with a separate hand. An auditory and a visual control group each practiced only a unisensory version of the task where response was with one hand. All events were of 2-sec duration and had time certainty, but the type of event occurring next in the series could be either certain or uncertain. The results revealed a net superiority of bisensory over unisensory responding when stimulus events were certain since an individual usually made the 2 response movements together in the bisensory task and anticipation of certain events resulted in an increase of speed of the visual response time compared to that of the audio response time. However, when events were uncertain impairment was inferred for bisensory responding since the audio response time was synchronized with the slower visual response time. (Contractor's abstract)

902

Illinois U. Electrical Engineering Research Lab., Urbana.

ELECTRON CYCLOTRON AS A SOURCE OF MEGAVOLT BUNCHED ELECTRON BEAMS, by I. Kaufman and P. D. Coleman. [1956] [2]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)62] and Air Force Cambridge Research Center under AF 19(604)524) Unclassified

Published in Jour. Appl. Phys., v. 27: 1250-1251, Oct. 1956.

An electron cyclotron has been shown to be a compact source of million volt electrons. Recent experiments show that this device may be used as a source of tightly bunched electron beams as well. Results of computations carried out for a specific set of parameters indicate that an initial phase increment of 8° is compressed into 0.5°, corresponding to an additional effective frequency multiplication of 16.

903

Illinois U. Electrical Engineering Research Lab., Urbana.

MAGNETODYNAMIC DIPOLAR FERRITE MODES, by W. H. Steier. Jan. 15, 1960, 74p. incl. diagrs. tables, refs. (Technical note no. 2) (AFOSR-TN-60-135) (AF 18(603)62) AD 232990; PB 145732
Unclassified

An experimental and theoretical investigation has been made of the magnetodynamic dipolar modes of a ferrite rod between conducting sheets. Critically coupled mode Q's as high as 1100 have been measured. The derived characteristic equation for these modes includes propagation effects. Contrasted to the magnetostatic modes, the ferrite sample size can therefore be large compared to a wavelength. Modes charts for the (0,1,m), (0,2,m), and (0,3,m) modes have been numerically calculated for Ferramic R-1 and polycrystalline YIG for 3 values of the ratio l/m. The mode charts have a range of bias fields from 3 to 20 kiloöersteds and a range of frequencies from 4 to 50 kmc. Two types of cutoffs for these modes are discussed and formulas for determining when they occur are presented. To facilitate coupling to the modes, diagrams of the $\vec{B}$ and $\vec{E}$ fields for a typical mode are shown. These modes have been experimentally observed at X and K bands in both Ferramic R-1 and YIG. Good agreement is shown between the theory and the experiment in all cases. The coupling structures which enabled the ferrite resonators to be critically matched to the waveguide input are described. Mode Q's have been experimentally measured in both bands and their variation with bias field is reported. The advantages which these modes possess over other solved ferrite modes are pointed out. They include: (a) relatively high Q, (b) ability to critically couple, and (c) sample size is comparable to the wavelength. (Contractor's abstract)

904

Illinois U. Electrical Engineering Research Lab., Urbana.

THEORY AND APPLICATION OF DIPOLAR FERRITE MODES, by W. H. Steier and P. D. Coleman. [1960] [2]p. incl. diagrs. (AFOSR-3265) [AF 18(603)62]
Unclassified

Presented at Fifth Conf. on Magnetism and Magnetic Materials, Detroit, Mich., Nov. 16-19, 1959.

Also published in Jour. Appl. Phys., Suppl., v. 31: 99S-100S, May 1960.

Modes for three values of l/m or length of ferrite rod/no of axial variations (l/m = 1.00, 0.50, and 0.30 cm), have been observed at x and K band in both. Ferramic R-1 and polycrystalline YIG. In all cases the experimental results are in good agreement with the characteristic equation which includes dipolar coupling between electron spins and propagation effects. The solution assumes the rod to approximate an ellipsoid and the permeability tensor is not a function of the spatial coordinates.

905

Illinois U. Electrical Engineering [Research Lab.] Urbana.

THE DIELECTRIC TUBE RESONATOR: A DEVICE FOR THE GENERATION AND MEASUREMENT OF MILLIMETER AND SUBMILLIMETER WAVES, by R. C. Becker and P. D. Coleman. [1960] [32]p. incl. diagrs. tables, refs. (AFOSR-J76) (Sponsored jointly by [Air Force Office of Scientific Research under AF 18(603)62] and Atomic Energy Commission under AT(11-1)392)
AD 400085 Unclassified

Also published in Proc. Symposium on Millimeter Waves, New York, N. Y. (Mar. 31-Apr. 2, 1959), Brooklyn, Polytechnic Inst. of Brooklyn Press, 1960, p. 191-222.

The ultramicrowave problem, i.e., the present inability to utilize satisfactorily that portion of the electromagnetic spectrum extending from 300 to 3000 kmc/sec ($0.1 \text{ mm} < \lambda_0 \leq 1.0 \text{ mm}$), is essentially twofold: (1) There does not exist a source of high-power, coherent, monochromatic signal frequencies suitable for exploratory and diagnostic research in the fields of physics and communications engineering. (2) Techniques for detection, transmission and measurement of these signal frequencies remain practically unexplored, due principally to the absence of such a source. As a solution to some of the problems associated with both aspects of the submillimeter wave problem, the dielectric tube resonator was proposed. It, reportedly, possesses the following unique properties which should make possible the extension of microwave techniques to wavelengths well below 1 mm. Its mode separation capability allows the mode charts to vary as a function of the dielectric constant and wall thickness of the dielectric tube. This mode property permits the use of higher order modes over given theoretical mode-interference-free bandwidths, and thereby affords higher values of Q. Symmetrical mode solutions to the boundary value problem simultaneously provide improved electrical performance and physical structure that are at least three times larger than the equivalent metal cavity. In addition longer interaction distances are possible in beam coupling applications since the phase velocity of the resonator fields can be made equal to the electron beam velocity. Applications of the dielectric tube resonator as a beam-coupling structure and as a frequency meter for millimeter and submillimeter wavelength are described also. Experimental verification of the theoretical behavior of this device is included. (Contractor's abstract, modified)

906

Illinois U. Electrical Engineering [Research Lab.] Urbana.

HIGH POWER GAS DISCHARGE FREQUENCY MULTIPLIER, by J. R. Baird and P. D. Coleman. [1960] [12]p. incl. illus. diagrs. refs. (AFOSR-J79) (Sponsored jointly by [Air Force Office of Scientific Research under AF 18(603)62] and Atomic Energy Commission under AT(11-1)392) Unclassified

Also published in Proc. Symposium on Millimeter Waves, New York, N. Y. (Mar. 31-Apr. 2, 1959), Brooklyn, Polytechnic Inst. of Brooklyn Press, 1960, p. 289-300.

It is well known that a gas discharge possesses nonlinear properties. However, at the present time these properties have not been exploited for the production of low-millimeter and submillimeter waves. This paper describes preliminary results on an X-band, crossed-guide type of gas discharge multiplier driven by a 10-kw, pulsed magnetron. While only the first 11 harmonics have been measured, it appears certain that harmonic wavelengths below 3 mm exist. The present structural features of the multiplier permit construction of devices having drive frequencies as high as 75 kmc/sec, since no external magnetic field bias is required. Hence, there is a good prospect that the device will be capable of producing appreciable power well below 1 mm wavelength. (Contractor's abstract)

907

Illinois U. [Electrical Engineering Research Lab.] Urbana.

A MEGAVOLT ELECTRONICS CERENKOV COUPLER AND RADIATOR, by P. D. Coleman and C. Enderby. [1960] [2]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)-62] and Atomic Energy Commission [under AT(11-1)-392]) Unclassified

Published in Jour. Appl. Phys., v. 31: 1695-1696, Sept. 1960.

A bunched, megavolt electron beam is used to produce radiation by means of a simple, dielectric Cerenkov cone which serves simultaneously as an energy converter and radiator. An accurate calculation of the power can be made by considering the simple problem of a beam passing through a hole in an infinite dielectric medium. For this case it is only necessary to solve the scalar potential φ equation

$$\nabla^2\varphi + k^2\varphi = -\sum_n \frac{\rho_n}{\epsilon_0} \epsilon\, i/n\omega_0(t-z|v)$$ appropriate to each region and evaluate the constants in the solutions by using the boundary conditions.

908

Illinois U. Electrical Engineering Research Lab., Urbana.

A SYNTHESIS PROCEDURE BASED ON LINVILL'S RC ACTIVE STRUCTURE, by J. B. Cruz, Jr. [1958] [2]p. incl. diagrs. (AF 49(638)63) Unclassified

Published in I.R.E. Trans. on Circuit Theory, v. CT-6: 133-134, Mar. 1959.

In Linvill's active network configuration, NIC (negative impedance converter) is assumed to be of the voltage inversion type. Results for current inversion type NIC could be obtained similarly by expressing the chain matrix elements of the subnetworks, in terms of open-circuit network functions and multiplying the chain matrices of the subnetworks. The final network design is presented in diagram form with the NIC and load resistance connected. The actual transfer function for a voltage inversion type NIC is $\frac{V_2(s)}{V_1(s)} = \frac{R_1(s^2 - 2s + 5)(s + \frac{9}{4})}{(s^2 + 2s + 5)(s + 3)}$. For a current-inversion type NIC, $V_2(s)/V_1(s)$ is simply the negative of the above.

909

Illinois U. Electrical Engineering Research Lab., Urbana.

THE APPROXIMATION OF NETWORK FUNCTIONS USING TCHEBYCHEFF POLYNOMIALS, by S. Karni. Mar. 18, 1960 [63]p. incl. diagrs. tables, refs. (Technical note no. 12) (AFOSR-TN-60-342) (AF 49(638)63) AD 236161; PB 146920 Unclassified

Approximation is accomplished by expanding the prescribed response function and an assumed network response function in series of Tchebycheff polynomials. Matching a finite number of terms in the two series determines the desired network function and the error of approximation. The results include a method for the derivation of Padé approximants from the Tchebycheff polynomials series expansion of the prescribed gain, a procedure for the reduction of network complexity, and a technique for the matching of the power series expansions of the derivative of a prescribed gain function with that of a network function. The theoretical developments are supported by step-by-step procedures for use in design problems. The methods are illustrated by the following examples: (1) the equalization of gain distortion resulting from one or more poles on the negative real axis by means of all-pole network functions, (2) a method for the exact equalization of gain distortion in the approximation band, (3) the approximation of the so-called brick wall and the linearly decreasing gain functions by means of biquadratic network functions, and (4) the reduction of the degree of a given network function. (Contractor's abstract)

910

Illinois U. Electrical Engineering Research Lab., Urbana.

SYNTHESIS OF DOUBLE-TERMINATED ACTIVE NETWORKS, by K. S. Fu. Mar. 4, 1960, 29p. incl. diagrs. tables, refs. (Technical note no. 11) (AFOSR-TN-60-368) (AF 49(638)63) AD 236097; PB 146919 Unclassified

Methods are given for the synthesis of double-terminated active networks for zeros of transmission at zero, infinity, and on the imaginary axis, and also complex zeros of transmission. The network configuration used is a bridge-type active network containing negative impedance converters. (Contractor's abstract)

911

Illinois U. Electrical Engineering Research Lab., Urbana.

RATIONAL APPROXIMATION OF ARBITRARY REAL FUNCTIONS WITH SPECIFIED WEIGHTS, by T.-N. Tang. May 1, 1960 [95]p. incl. diagrs. table, refs. (Technical note no. 14) (AFOSR-TN-60-613) (AF 49-(638)63) PB 148766 Unclassified

A polynomial or a rational function which approximates a real continuous function in a closed interval in the Tchebycheff sense with a specified weighting function is obtained through the processes involving iterative procedures. The effect of zero shifting on the error function is analyzed with results applied to obtain the Tchebycheff solution of a polynomial or a rational function approximation problem. The extrema minimization method is extended to cover the case of a rational function approximation as well as the case of a polynomial approximation. The use of an integral measure of error when the function is piecewise continuous is investigated with some symmetry properties observed.

912

Illinois U. Electrical Engineering Research Lab., Urbana.

NEW TECHNIQUES IN SWITCHED CIRCUIT SYNTHESIS, by D. L. Epley. May 1, 1960 [99]p. incl. diagrs. tables, refs. (Technical note no. 13) (AFOSR-TN-60-614) (AF 49(638)63) AD 238868; PB 148765 Unclassified

Three new switching theory concepts and methods analogous to electrical network theory methods are defined and applied to problems in switching circuit synthesis. The first, the removal synthesis technique, is used to synthesize transmission contact networks with p input terminals and q output terminals. The second new concept introduced is the 0, 1-configuration of a switching function. Using this representation of switching functions and a mapping procedure, a new method of finding the minimum sums of a given function is developed. The third concept, sensitivity of a contact circuit to contact errors, is used to design circuits with error protection.

913

Illinois U. Electrical Engineering Research Lab., Urbana.

TRANSFER FUNCTION SYNTHESIS BASED ON CASCADED RC AND RL NETWORKS, by D. A. Calahan. Sept. 1, 1960 [124]p. incl. diagrs. tables, refs. (Technical note no. 15) (AFOSR-TN-60-1024) (AF 49(638)63) AD 244368; PB 152486 Unclassified

A method of partitioning transfer functions into RC and RL subnetwork functions is developed. It is shown that the poles of any transfer function realizable by cascaded RC and RL subnetworks are restricted by the condition $\Sigma \arg s_i \leq \frac{\pi}{2}$ where the $-s_i$ are the upper half plane complex poles. Sufficient conditions are derived for the realization of any transfer function in the RC-RL form. A procedure is also developed for maximization of the gain constant of certain classes of transfer functions when realized by this model. An active network structure, first proposed by Horowitz and consisting of RC networks cascaded with an inverter (gyrator), is shown to have transfer functions similar to the RC-RL passive model when both are written in terms of subnetwork functions. The realizability conditions derived for the latter are applied to the active model. In addition, the sensitivity of the transfer function poles to changes in the inverter is studied. A partitioning procedure is developed which simultaneously minimizes sensitivity at all poles. It is shown that this minimum pole sensitivity to the active element is always less than that obtainable by other active models involving partitioning into positive and negative RC subnetwork functions. (Contractor's abstract)

914

Illinois U. Electrical Engineering Research Lab., Urbana.

SYNTHESIS OF RC LADDER NETWORKS WITH SPECIFIED DRIVING-POINT AND TRANSFER FUNCTIONS, by J. R. Young. Sept. 9, 1960 [72]p. incl. diagrs. refs. (Technical note no. 16) (AFOSR-TN-60-1090) (AF 49-(638)63) AD 244369; PB 152489 Unclassified

Necessary and sufficient conditions are stated for the realizability of the short-circuit admittance functions and the open-circuit impedance of functions of high-pass and low-pass simple RC ladders. Synthesis of these simple RC ladders is accomplished through the use of formulas which simultaneously reduce driving-point functions and the transfer function. Double zeros of Δ and Δ_{1122} are shown to occur when the open-circuit impedance functions or the short-circuit admittance functions, respectively, have noncompact poles. The Fialkow-Gerst coefficient conditions and the residue

condition are shown to be sufficient for the realization of the short-circuit admittance functions or the open-circuit impedance functions of a low-pass or high-pass modified simple RC ladder. Shunt resistors or capacitors are added to the conventional low-pass or high-pass simple ladder to form a modified ladder. (Contractor's abstract)

915

[Illinois U. Electrical Engineering Research Lab., Urbana.]

ON THE SYNTHESIS OF ACTIVE NETWORKS WITH ONE NEGATIVE IMPEDANCE CONVERTER, by R. T. Chien. [1960] [7]p. incl. diagrs. (AFOSR-3594) (AF 49(638)63) Unclassified

Also published in Proc. Nat'l. Electronics Conf., v. 16: 405-411, 1960.

The Linvill configuration is used to synthesize second-order nonpositive-real driving-point functions. Synthesis is accomplished by means of an arbitrary surplus factor which controls the driving-point function. The existence of the solution is demonstrated and the minimum number of elements property of the solution is proved. It is shown that only 5 elements are required beside the NIC (negative impedance converter). (Contractor's abstract, modified)

916

Illinois U. Electrical Engineering [Research Lab.] Urbana.

NOTES ON THE HOROWITZ OPTIMIZATION PROCEDURE, by D. A. Calahan. [1960] [3]p. incl. diagrs. (AFOSR-3597) [AF 49(638)63] Unclassified

Also published in I.R.E. Trans. on Circuit Theory, v. CT-7: 352-354, Sept. 1960.

Factoring makes it possible to eliminate the need for solving a large number of nonlinear simultaneous equations in the Horowitz optimization procedure. Decomposition of the essential function is detailed in a three-step procedure. The only decomposition that cannot be improved by one of the three steps must possess the unique characteristics of the Horowitz decomposition.

917

Illinois U. [Electrical Engineering Research Lab.] Urbana.

MEASURES OF SENSITIVITY FOR LINEAR SYSTEMS WITH LARGE MULTIPLE PARAMETER VARIATIONS, by S. L. Hakimi and J. B. Cruz, Jr. [1960] [8]p. incl. diagrs. refs. (AFOSR-3849) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)63; and Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-56695) Unclassified

Presented at I.R.E. Western Electronic Show and Convention, Los Angeles, Calif., Apr. 1960.

Also published in I.R.E. WESCON Convention Record, pt. 2: 109-115, 1960.

The problem considered in this paper is the characterization of the deviation of a system function when the element values are allowed to deviate from the designed or nominal values. It is shown that it is possible for the system function deviation to decrease as the element value deviations increase so that it is not sufficient to examine the system function only when the element values attain maximum or minimum values as specified by their tolerances. The upper and lower bounds on the transmission or system function are obtained for all possible combinations of element deviations within specified tolerance limits. Uniform and normal probability density functions are considered for the element deviations assumed to be random variables. A pseudo-Monte Carlo method is used for determining an rms system function deviation. From the necessary finite number of random sets of element deviations used in a digital computer calculation, the largest and smallest system function obtained may be used as guides in resetting the element tolerances to meet specifications on the system function deviation. (Contractor's abstract, modified)

918

Illinois U. Electrical Engineering Research Lab., Urbana.

THE SYNTHESIS OF MODELS FOR TIME-VARYING LINEAR SYSTEMS, by J. B. Cruz, Jr. and M. E. Van Valkenburg. [1960] [27]p. incl. diagrs. refs. (AFOSR-3851) (Sponsored jointly by Air Force Office of Scientific Research and Signal Corps under DA 36-039-sc-56695) Unclassified

Also published in Active Networks and Feedback Systems, Proc. of Symposium, New York (Apr. 19-21, 1960), Brooklyn, Polytechnic Press, v. 10: 527-544, 1961. (AFOSR-718)

Models of time-varying linear systems are synthesized utilizing fixed linear subsystems and time-varying gain amplifiers. Specifications are considered in the time-domain, frequency domain, and a general λ domain. An integral part of most of the procedure is an approximation using a truncated expansion of the system function in terms of separable functions. For illustrating the procedure, the least integral square error criterion is chosen and, consequently, an orthogonal expansion is involved. (Contractor's abstract, modified)

919

Illinois U. [Electrical Engineering Research Lab.] Urbana.

THE USE OF THE ACTIVE LATTICE TO OPTIMIZE TRANSFER FUNCTION SENSITIVITIES, by R. E. Thomas. [1960] [10]p. incl. diagrs. (AFOSR-2857) (AF 49(638)-63) Unclassified

Also published in Active Networks and Feedback Systems, Proc. of Symposium, New York (Apr. 19-21, 1960), Brooklyn, Polytechnic Press, v. 10: 179-188, 1961. (AFOSR-718)

920

Illinois U. [Electrical Engineering Research Lab.] Urbana.

ACTIVE SYNTHESIS BY R-RL PARTITIONING, by D. A. Calahan. [1960] [1]p. incl. diagrs. (AFOSR-3859) [AF 49(638)63] Unclassified

Presented at 1960 Northeast Electronics Research and Engineering Meeting, Boston, Mass., Nov. 15-17, 1960.

Also published in NEREM Record, v. 2: 82, 1960.

For realization of a transfer function without the use of inductors, it has been common to partition the function into subnetwork functions which may be realized by a combination of RC networks and an active device. The use of an inverter (gyrator) as an active element has been investigated only for low order transfer functions. This report extends these results to higher order functions. It is demonstrated that the following conditions are sufficient and nearly always necessary for realization: (1) N(p) has no positive real zeros, (2) $\sum_{1}^{m} \arg s_i < \pi/2$, (3) $p_i > 0$ and (4) $t_{21}(\infty) < \infty$.

921

Illinois U. Electrical Engineering Research Lab., Urbana.

A DERIVATION OF THE VOLTAGE-TRANSFER FUNCTION FROM A PRESCRIBED GAIN FUNCTION BY MATCHING DERIVATIVES, by S. Karni. [1960] [1]p. [AF 49(638)63] Unclassified

Published in I.R.E. Trans. on Circuit Theory, v. CT-6: 352, Sept. 1960.

Given a prescribed gain, $\alpha_p = \frac{A(\omega^2)}{B(\omega^2)}$ and the voltage-transfer function of a finite, realizable network, $G(s) = \frac{P(s)}{Q(s)}$, the problem of deriving $P_1(\omega^2)$ and $Q_1(\omega^2)$ and thereby G(s) is solved in the following way. Differentiate the gain of the voltage-transfer function, $\alpha = \frac{1}{2} \log \left(\frac{P_1(\omega^2)}{Q_1(\omega^2)}\right)$ with respect to ω^2 and obtain, $\frac{d\alpha}{d(\omega^2)} = \frac{1}{2}\left(\frac{P_1'}{P_1} - \frac{Q_1'}{Q_1}\right)$. Differentiate $\alpha_p = \frac{A(\omega^2)}{B(\omega^2)}$ in the same manner, obtaining, $\frac{d\alpha_p}{d(\omega^2)} = \frac{C}{D}$ where $C/D = d/d(\omega^2)\,[A(\omega^2)/B(\omega^2)]$. P_1 and Q_1 are such that $\frac{1}{2}\left(\frac{P_1'}{P_1} - \frac{Q_1'}{Q_1}\right) = \frac{C}{D}$ which expresses the equality between the derivatives of two gain functions.

922

Illinois U. [Electrical Engineering Research Lab.] Urbana.

STOCHASTIC ANALYSIS OF AUTOMATIC TRACKING SYSTEMS, by J. P. Ruina and M. E. Van Valkenburg. [1960] [6]p. incl. diagrs. refs. (Sponsored jointly by Air Force [Office of Scientific Research] under [AF 49-(638)63], Office of Naval Research, and Office of Ordnance Research) Unclassified

Published in Automatic and Remote Control, Proc. of First Internat'l. Congress of Internat'l. Federation of Automatic Control, Moscow (USSR) (1960), London, Butterworths, v. 2: 810-815, 1961.

Auton atic tracking systems are analyzed by a method which overcomes in part the following limitations: (1) the error detector is linear for only a small range of signals and (2) the mean square error criterion is not pertinent for a large class of applications. The Fokker-Planck diffusion equation is used to determine the probability distribution of the output and from this the probability of loss is found as a function of various system parameters. (Contractor's abstract, modified)

923

Illinois U. Electrical Engineering [Research Lab.] Urbana.

DYNAMIC CROSSED FIELD ELECTRON BUNCHING AND MULTIPLICATION, by D. F. Holshouser. Feb. 6, 1959, 32p. incl. diagrs. (AFOSR-TN-60-142) (AF 49-(638)556) AD 282854 Unclassified

The behavior of electrons in a field composed of a high-frequency electric field E sin ωt and a crossed steady magnetic field, B, is described. For certain B/ω ratios, electrons introduced into this field region during a small phase interval become tightly bunched and are accelerated to sufficient energy to produce secondary-emission. The secondary electrons repeat the process producing a bunched electron current which can be removed after any number of multiplication steps. The dynamic crossed-field multiplier produces an output current which is linearly related to the primary current and could conceivably be incorporated in a vacuum tube performing: (a) amplication of a range of signal frequencies, (b) detection of modulated low level light signals, (c) heterodyne signal detection, (d) generation of extremely short pulses, and (e) generation of driving frequency harmonics.

924

Illinois U. Engineering Experiment Station, Urbana.

RESEARCH ON TRANSONIC AND SUPERSONIC FLOW OF A REAL FLUID AT ABRUPT INCREASES IN CROSS SECTION (WITH SPECIAL CONSIDERATION OF BASE DRAG PROBLEMS), by H. H. Korst, W. L. Chow, and

G. W. Zumwalt. Final rept. Dec. 1959 [156]p. incl. diagrs. table, refs. (Technical note no. 392-5) (AFOSR-TR-60-74) (AF 18(600)392) AD 239139; PB 149174
Unclassified

A general theory for pressures and temperatures in separated transonic and supersonic flows is developed using a physically perceptive model composed of simplified flow components. The principle of interaction between dissipative and free stream flow regions (item no. ILL.15:002, Vol. I) allows distinction between inviscid flow configurations and superimposed jet mixing regions. Treatment of the latter is based on concepts developed previously (item no. ILL.15:001, Vol. I), and on tabulated results for fully developed isoenergetic and non-isoenergetic, constant pressure turbulent ($Pr_t = 1$) compressible two-dimensional mixing regions.

Problems in internal and external flow, ranging from the classical base pressure problem to the performance of supersonic ejectors and the detailed study of the jet slipstream interaction (afterbody) problem are analyzed theoretically. (Contractor's abstract)

925

Illinois U. Engineering Experiment Station, Urbana.

TRUNCATED CONE IN SUPERSONIC FLIGHT AT ZERO ANGLE OF ATTACK. SURFACE PRESSURE COEFFICIENTS, DRAG COEFFICIENTS, AND SHOCK FRONT CONFIGURATIONS, by W. L. Chow, H. H. Korst, and C. C. Tsung. Jan. 1960 [13]p. incl. diagrs. (Technical note no. 392-6) (AF 18(600)392)
Unclassified

The results of calculations to determine pressure distributions over truncated cone shaped afterbodies in supersonic flight with zero angle of attack are reported. The numerical computations were carried out as a side activity in connection with a comprehensive research program on jet-slipstream interaction pertaining to jet engines and missiles flying at supersonic speed. The calculations are based on the Method of Characteristics for axially symmetric supersonic flow and the oblique shock relations, disregarding the vorticity behind the curved shock front. The results cover half-cone angles up to 20° (at 5° intervals) at Mach numbers of 1.5, 2.0, 2.5, 3.0 and 3.5. (Contractor's abstract)

Imperial Coll. of Science and Tech. (Gt. Brit.).
see London U. Imperial Coll. of Science and Tech. (Gt. Brit.).

926

Indiana U. Dept. of Chemistry, Bloomington.

HIGH RESOLUTION KINETIC SPECTROSCOPY BY A MULTIPLE FLASH METHOD, by H. H. Kramer, M. H. Hanes, and E. J. Bair. Feb. 28, 1961 [15]p. incl. illus. diagrs. refs. (AFOSR-TN-60-1426) (AF 18(603)-93) AD 253824; PB 155625
Unclassified

Also published in Jour. Opt. Soc. Amer., v. 51: 775-779, July 1961.

Experiments are described in which double-beam absorption measurements are made at high spectral resolution (better than 0.05A in the visible and near ultraviolet) at an accurate sequence of time intervals as short as 200 μsec. This is accomplished with a high-resolution monochromator and dual-photomultiplier detector using a stroboscopic xenon flash source. Signals representing the absorption ratios are recorded on magnetic tape and read out with a digital integrator. A quantitative test of this procedure was made by observing the iodine recombination reaction following flash photolysis. The accuracy of the results compares favorably with previous measurements which have used spectral bandwidths a thousand times broader. The use of this method for measuring rate of free-radical reactions is described using observations of NH_2 radicals as an illustration. (Contractor's abstract)

927

Indiana U. Dept. of Chemistry, Bloomington.

ELECTRONIC COMMUTATOR METHOD FOR DETERMINING E^0 OF FORMATION OF FUSED HALIDES, by A. F. Wilde and R. L. Seifert. [1960] [5]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1033) [AF 49(638)313] AD 268113
Unclassified

Also published in Jour. Electrochem. Soc., v. 108: 1059-1063, Nov. 1961.

Previous experimental determinations of the electrode potential (E^0) of formation of fused metal halides have depended largely on the equilibrium cell method rather than the simpler, but less precise, decomposition potential method. A modification of the latter method is described which provides some improvements. This technique, with its simple cell and electrodes, was used to evaluate the E^0 of formation for fused AgCl in the temperature range 500-907°C in direct comparison with the equilibrium cell method. The results agree well with equilibrium cell values obtained both in this study and by other investigators. (Contractor's abstract)

928

Indiana U. Dept. of Chemistry, Bloomington.

FIRST EXCITED $^1\Sigma_g^+$ STATE OF H_2. A DOUBLE-MINIMUM PROBLEM, by E. R. Davidson. [1960] [1]p. incl. diagr. (AFOSR-TN-60-959) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)318] and National Science Foundation) Unclassified

Also published in Jour. Chem. Phys., v. 33: 1577, Nov. 1960.

The potential cruve for the 1st-excited $^1\Sigma_g^+$ state was calculated by the linear variation method, using a 20-term expansion in elliptical coordinates without explicit r_{12} dependence. The potential curve contained 2 deep minima.

929

Indiana U. Dept. of Chemistry, Bloomington.

COMPARISON OF THEORETICAL CALCULATIONS ON DIATOMIC MOLECULES WITH EXPERIMENT, by E. R. Davidson. [1960] [3]p. incl. tables. (AFOSR-TN-60-1034) (AF 49(638)318) Unclassified

Also published in Jour. Chem. Phys., v. 34: 1240-1242, Apr. 1961.

A method for the numerical computation of the vibrational-rotational term levels from an arbitrary potential curve is presented. In this method, the potential curve is approximated by a step function and the exact eigenvalue of this latter function are found by an iteration technique. The accuracy of this method is demonstrated by finding the term levels for a Morse potential and for the ground state of H_2.

930

Indiana U. [Dept. of Chemistry] Bloomington.

ELECTRONIC STRUCTURE OF THE GROUND STATE OF THE LITHIUM HYDRIDE MOLECULE, by D. D. Ebbing. Sept. 1, 1960 [81]p. incl. tables, refs. (AFOSR-TN-60-1131) (AF 49(638)318) AD 249986; PB 154352 Unclassified

A set of orbitals in elliptical coordinates were used as a basis in a self-consistent field configuration interaction (SCF-CI) study of the electronic structure of the ground state of the lithium hydride molecule. The results of each configuration interaction calculation were analyzed into contributions to the innershell and outershell correlation energies, and in this way the importance of various orbitals was studied and related to correlation effects. Those configurations are most important which have either the inner-shell molecular orbital or the valence-shell molecular orbital doubly occupied. The best energy obtained, using 53 configurations formed from a basis of 7 σ and 3 π orbitals, is -8.04128 Hartrees at an internuclear separation of 2.99 Bohr radii. The dipole moment was calculated to be 5.96 Debyes. (Contractor's abstract, modified)

931

Indiana U. Dept. of Chemistry, Bloomington.

ELECTRONIC CORRELATION ENERGY IN 3- AND 4-ELECTRON ATOMS, by J. Linderberg and H. Shull. [1960] [16]p. incl. diagrs. tables, refs. (AFOSR-3798) (In cooperation with Uppsala U. (Sweden), AF 61(514)-1200) (Sponsored jointly by Air Force Office of Scientific Research under (AF 49(638)318) and National Science Foundation) Unclassified

Also published in Jour. Molec. Spectros., v. 5: 1-16, July 1960.

The electronic correlation energy in 3- and 4-electron atomic systems is compared to previously well-established correlation energies in 2-electron atoms. The distribution of correlation in the K shell of these atoms between radical and angular correlation parallels that of the 2-electron system very closely. In the L shell, the Be ground state is almost purely angular correlation energy. There is negligible correlation energy associated with K-L interaction. Analysis of the Z dependence of the correlation energy of 4-electron atoms shows a term linear in Z. Possibly, this term arises from degeneracies existing in the limit of finite Z, and a tabulation of states expected to have this property is given. The analysis suggests a scheme for constructing a semiempirical method for estimating atomic energies rather accurately. (Contractor's abstract)

932

Indiana U. Dept. of Chemistry, Bloomington.

THE NATURE OF THE TWO-ELECTRON CHEMICAL BOND. I. THE HOMOPOLAR CASE, by H. Shull. [1959] [9]p. incl. diagrs. tables, refs. (AFOSR-3799) (In cooperation with Uppsala U. (Sweden), AF 61(514)1200) (Sponsored jointly by Air Force Office of Scientific Research under (AF 49(638)318), Alfred P. Sloan Foundation, and National Science Foundation) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 1287-1295, Mar. 20, 1960.

By using the artifice of dividing space into two parts by means of a plane perpendicular to the internuclear axis and passing through its midpoint, it is shown that it is possible to divide a two-configuration two-electron wave function into two orthogonal parts each of which has optimum properties associated with the plane intuitively corresponding to the names ionic and atomic. The division of the density distributions of Wang, Weinbaum, and Rosen functions into ionic, atomic and ionic-atomic cross-term parts is considered and it is shown that the first two parts are roughly non-bonding, whereas the last part contributes most to the density between the nuclei in the binding region. Consequently, the term, covalent, seems best applied to the cross-term. (Contractor's abstract)

933

Institute for Advanced Study, Princeton, N. J.

ON A COLORING PROBLEM, by E. Asplund and B. Grünbaum. Dec. 1959, 11p. incl. diagrs. (AFOSR-TN-60-29) (AF 49(638)253) AD 232951; PB 146317 Unclassified

Also published in Math. Scand., v. 8: 181-188, 1960.

A problem posed by A. Bielecki (Colloquium Math., v. 1: 333, 1948) is solved by the following theorem: Each family of rectangles in the plane, with horizontal and vertical edges, and such that no three have a common point, may be decomposed into six subfamilies consisting of mutually disjoint rectangles. Some related problems and results are discussed. (Contractor's abstract)

934

Institute for Advanced Study, Princeton, N. J.

AN INITIAL VALUE PROBLEM FOR POSITIVE SYMMETRIC HYPERBOLIC SYSTEMS, by M. Lees. Dec. 1959, 12p. (AFOSR-TN-60-30) (AF 49(638)253) AD 232920 Unclassified

An initial value problem for a symmetric hyperbolic system of partial differential equations is investigated. The matrices of the system are assumed to be symmetric and positive definite. An initial value problem, distinct from the Cauchy problem, is posed. The existence and uniqueness of a solution of this initial value problem is proven for all sufficiently smooth data. A description is given of an effective numerical procedure for approximating it.

935

Institute for Advanced Study, Princeton, N. J.

PARTITIONS OF MASS-DISTRIBUTIONS AND OF CONVEX BODIES BY HYPERPLANES, by B. Grünbaum. Jan. 1960, 5p. (AFOSR-TN-60-110) (AF 49(638)253) AD 232950; PB 146086 Unclassified

Also published in Pacific Jour. Math., v. 10: 1257-1261, 1960.

Each half-space of E^n which contains the centroid of a convex body K, i.e., $K \subset E^n$, is shown to contain more than $1/e = 0.3678...$ of the volume of K. Related results are proved for arbitrary mass-distributions in E^n. (Contractor's abstract)

936

Institute for Advanced Study, Princeton, N. J.

THE BACKWARD CAUCHY PROBLEM FOR PARABOLIC DIFFERENTIAL INEQUALITIES, by M. Lees. Jan. 1960, 6p. (AFOSR-TN-60-112) (AF 49(638)253) AD 232949; PB 146085 Unclassified

An elementary proof is given of the uniqueness of the Cauchy problem for second order parabolic equations and inequalities. (Contractor's abstract)

937

Institute for Advanced Study, Princeton, N. J.

A NONLINEAR TWO-POINT BOUNDARY VALUE PROBLEM, by M. Lees. Jan. 1960, 14p. incl. refs. (AFOSR-TN-60-140) (AF 49(638)253) AD 232948; PB 146090 Unclassified

Existence, uniqueness, and finite-difference approximation theorems are obtained for a 2-point boundary value problem for the differential equation $u'' = f(x, u, u')$. The results require that the function f(x, z, p) be such that $\partial f/\partial_p$ is uniformly bounded and that $\partial f/\partial z$ be bounded from below by zero and from above by a continuous function of z alone. (Contractor's abstract)

938

Institute for Advanced Study, Princeton, N. J.

ON A MEASURE OF ASYMMETRY OF CONVEX BODIES, by E. Asplund, E. Grosswald, and B. Grünbaum. Mar. 1960, 6p. (AFOSR-TN-60-359) (AF 49(638)253) AD 236775; PB 147516 Unclassified

Also published in Proc. Cambridge Philos. Soc., v. 58: 217-220, 1962.

A new measure of asymmetry of convex bodies in Euclidean spaces is defined and some of its properties established. As far as is known, this is the first measure according to which the n-dimensional simplex is not the asymmetric n-dimensional convex body for $n \geq 3$. (Contractor's abstract)

939

Institute for Advanced Study, Princeton, N. J.

A MEASURE OF ASYMMETRY FOR CONVEX SURFACES, by E. Asplund, G. Bredon, and G. Grünbaum. Apr. 1960, 3p. (AFOSR-TN-60-403) (AF 49(638)253) AD 236773; PB 147518 Unclassified

Also published in Portugal. Math., v. 19: 185-187, 1960.

Generalizing results of G. v. Sz. Nagy (Portugal. Math.,

v. 8: 17-22, 1949) it is proved that the surface centroid of any convex body K in E^n, $n \geq 2$, divides the distance between any pair of parallel supporting hyperplanes of K in ratio less than 2n-1, this being the best possible bound. (Contractor's abstract)

940

Institute for Advanced Study, Princeton, N. J.

ON THE GEOMETRY OF MINKOWSKI PLANES, by E. Asplund and B. Grünbaum. Apr. 1960, 9p. (AFOSR-TN-60-436) (AF 49(638)253) AD 236774; PB 147517 Unclassified

Also published in L'Enseignement Math., Series 2, v. 6: 299-306, Oct.-Dec. 1960.

For any centrally symmetric, strictly convex set $K \subset E^2$ with smooth boundary B, the following theorem is established: If three translates of K cover B, they cover K too. This, and related propositions known for Euclidean circles, are proved for Minkowski planes. Some properties of convex curves which characterize centrally symmetric ones, or ellipses, are also discussed. (Contractor's abstract)

941

Institute for Advanced Study, Princeton, N. J.

AN EXACT SEQUENCE IN DIFFERENTIAL TOPOLOGY, by M. W. Hirsch. May 1960, 3p. (AFOSR-TN-60-544) (AF 49(638)253) AD 238158; PB 148326 Unclassified

Also published in Bull. Amer. Math. Soc., v. 66: 322-323, July 1960.

For each positive integer n, abelian groups Γ^n, θ^n, and Λ^n are defined. Γ^n is the group of all diffeomorphisms of the (n - 1)-sphere S^{n-1} modulo the normal subgroup of those diffeomorphisms that are extendable to the n-ball. θ^n is the set of J-equivalence classes of compact, oriented, differentiable n-manifolds, that are homotopy spheres; two such oriented manifolds, M and N, are defined to be J-equivalent if there is an oriented (n + 1)-manifold X whose boundary is the disjoint union of M and -N and which admits both M and N as deformation retracts. The sum of two J-equivalent classes is defined by forming the sum of two representative manifolds in the usual way. The group Λ^n is defined in an analogous way using combinatorial manifolds instead of differentiable manifolds. Next, the homomorphisms $j: \Gamma^n \to \theta^n$, $k: \theta^n \to \Lambda^n$, and $d: \Lambda^n \to \Gamma^{n-1}$ are defined. Here k associates with each J-equivalent class of differentiable manifolds the corresponding equivalent class of combinatorial manifolds determined by a smooth triangulation. The definitions of j and d are more involved. The sequence $\ldots \to \Gamma^n \to \theta^n \to \Lambda^n \to \Gamma^{n-1} \to \ldots$ is asserted as a theorem to be exact. The proof is not given here. (Math. Rev. abstract)

942

Institute for Advanced Study, Princeton, N. J.

ON EMBEDDING DIFFERENTIABLE MANIFOLDS IN EUCLIDEAN SPACE, by M. W. Hirsch. May 1960, 9p. incl. refs. (AFOSR-TN-60-545) (AF 49(638)253) AD 238157; PB 148327 Unclassified

Also published in Ann. Math., v. 73: 566-571, May 1961.

The purpose of this paper is to show how methods used to obtain results concerning rectilinear imbeddings of combinatorial manifolds in Euclidean n-space R^n can be used to obtain information about differential imbeddings of smooth manifolds in R^n. Several theorems are proven to obtain the basic results. Among these is the following: If M is a differentiable n-manifold, M can be embedded in Euclidean q-space R^q, where (1) $q = 2n-1$ if M is non-closed, (2) $q = n+2$ if M is contractible and n is odd, and (3) $q = n+1$ if M is contractible and n is even. Other results are obtained by assuming special conditions, e.g., M is parallelizable, or M is highly connected.

943

Institute for Advanced Study, Princeton, N. J.

ASYMPTOTIC DECAY OF SOLUTIONS OF DIFFERENTIAL INEQUALITIES, by P. J. Cohen and M. Lees. May 1960, 17p. (AFOSR-TN-60-568) (AF 49(638)253) AD 238159; PB 148328 Unclassified

Also published in Pacific Jour. Math., v. 11: 1235-1249, 1961.

An investigation is made of the maximum rate of decay at infinity of solutions of certain differential inequalities. Two types of differential inequalities are considered: abstract differential inequalities in a Hilbert space and concrete parabolic differential inequalities.

944

Institute for Advanced Study, Princeton, N. J.

PROPERTIES OF SOLUTIONS OF DIFFERENTIAL INEQUALITIES, by M. Lees. Aug. 1960 [13]p. (AFOSR-TN-60-1130) (AF 49(638)253) AD 244398 Unclassified

The maximum permissible rate of decay of solutions to certain abstract differential inequalities in a Hilbert space is investigated. These results are then applied to parabolic differential inequalities subject to general homogeneous boundary conditions. (Contractor's abstract)

945

Institute for Advanced Study, Princeton, N. J.

A PRIORI ESTIMATES FOR THE SOLUTIONS OF DIFFERENCE APPROXIMATIONS TO PARABOLIC PARTIAL DIFFERENTIAL EQUATIONS, by M. Lees. [1959] [15]p. incl. refs. (In cooperation with Brookhaven National Lab., Long Island, N. Y.) (AF 49(638)253) Unclassified

Published in Duke Math. Jour., v. 27: 297-311, 1960.

A priori estimates for solutions of several difference analogues of parabolic differential equations are derived in a systematic manner. All the standard two-level difference equations are treated, and two simple three-level difference formulae are considered. The arguments are presented in detail for the heat equation and generalizations are indicated. A number of the basic difference identities and inequalities that are useful in the energy approach are collected at the beginning of the article. (Math. Rev. abstract)

946

[Institute for Advanced Study, Princeton, N. J.]

THE GOURSAT PROBLEM, by M. Lees. [1960] [13]p. (AF 49(638)253) Unclassified

Published in Jour. Soc. Indust. Appl. Math., v. 8: 518-530, Sept. 1960.

Some facts are proven concerning existence, uniqueness and finite-difference approximation for a quasi-linear Goursat problem $\frac{\partial 2z}{\partial x \partial y} = A_1(x, y, z)p + A_2(x, y, z)q + A_3(x, y, z)$. Its initial data are prescribed on two intersecting characteristics. For the existence, it is assumed that the functions A_i $(i = 1, 2, 3)$ are measurable in (x, y) for each z, bounded for bounded z, and continuous in z for each (x, y). An existence theorem is given for linear equations with bounded measurable coefficients. The solution is obtained as a limit of a sequence of finite-valued step functions, where the height of the steps for each member of the sequence is determined by an algorithm suitable for practical computations. The result for linear equations and the fixed-point theorem of Schauder can be employed to prove an existence theorem for the quasi-linear equation. The solution is unique when the A_i satisfy a Lipschitz condition with respect to z. (Math. Rev. abstract)

947

Institute for Advanced Study, Princeton, N. J.

SOME HILBERT SPACES OF ENTIRE FUNCTIONS, by L. de Branges. [1960] [6]p. incl. refs. (AF 49(638)253) Unclassified

Published in Bull. Amer. Math. Soc., v. 67: 129-134, Jan. 1961.

Three theorems concerning a Hilbert space defined as a complete inner product space over the complex numbers, with no restriction on dimension are discussed. The space which actually occur are separable, but they may have finite dimension. The transformations are linear, but they may need not be everywhere bounded or defined. This space is introduced in an earlier paper (Proc. Amer. Math. Soc., v. 10: 840-846, 1959).

948

Institute for Advanced Study, Princeton, N. J.

THE SOLUTION OF POSITIVE-SYMMETRIC HYPERBOLIC SYSTEMS BY DIFFERENCE METHODS, by M. Lees. [1960] [10]p. (In cooperation with Brookhaven National Lab., Long Island, N. Y.) (AF 49(638)253) Unclassified

Published in Proc. Amer. Math. Soc., v. 12: 195-204, Apr. 1961.

Consider the system of differential equations $\sum_{i=1}^{n} A^i(x) \frac{\partial u}{\partial x_i} = F(x,u)$, where u and F are m-dimensional vector functions of the n-vector $x = (x_1, x_2, \cdots, x_n)$, and the $A^i(x)$ are positive definite matrices. On the coordinate hyper-planes $x_i = 0$, $i = 1, 2, \cdots, n$, there are prescribed initial values g^i for u. A solution is to be found in the region $x_i > 0$, $i = 1, 2, \cdots, n$. This initial-value problem is compared with the finite-difference problem in which the above equation is replaced by $\sum_{i=1}^{n} A^i(x) v_{\bar{x}_i} = F(x,v)$. Here $v_{\bar{x}_i}$ is the backward difference quotient of v in the i^{th} coordinate direction in an orthogonal grid of mesh length. An energy inequality for the solution v of the difference-equation problem is proven. This inequality gives bounds for v, in a mean square norm, in terms of the data. On the basis of this inequality the stability of the difference method is proven. Then, some additional inequalities for the difference quotients of v are derived, which are the basis of an equicontinuity argument which shows that, under suitable regularity assumptions, the differential-equation problem has a solution u. It further follows that, as h tends to zero, the difference v - u approaches zero in the norm. This implies the uniqueness of the solution u. The details of the proofs are carried out for the linear case only. (Math. Rev. abstract)

949

Institute for Advanced Study, Princeton, N. J.

SOME HILBERT SPACES OF ENTIRE FUNCTIONS. II, by L. de Branges. [1960] [35]p. (AF 49(638)253) Unclassified

Published in Trans. Amer. Math. Soc., v. 99: 118-152, Apr. 1961.

Some ideas associated with Theorem X of a previous report (Trans. Amer. Math. Soc., v. 96: 259-295, Aug. 1960) are discussed. The first part of the theorem is concerned with proving that if $E_0(t,z) = C_0(t,z) - iS_0(t,z)$ and $E(t,z) = C_1(t,z) - iS_1(t,z)$, then $|E_0(t,\bar{z})| \leq |E_0(t,z)|$ and $|E_1(t,\bar{z})| \leq |E_1(t,z)|$ for $y > 0$. The second part replaces t for n; C_0, S_0, C_1, and S_1 are real numbers such that $C_0C_1 + S_0S_1 = 1$. Several theorems related to the above are discussed within the context of the Hilbert space whose elements are entire functions and create especial interst by having the following 3 properties: (1) Whenever F(z) is in the Hilbert space and has a nonreal zero w, $F(z)(z-\bar{w})/(z-w)$ is in the Hilbert space and has the same norm as F(z). (2) Whenever w is a nonreal complex number, the linear functional defined on the Hilbert space by $F(z) \rightarrow F(w)$ is continuous. (3) Whenever F(z) is in the Hilbert space, the function $F^*(z) = \overline{F(\bar{z})}$ is in the Hilbert space and has the same norm as F(z).

Institute for the Study of Rate Processes, Salt Lake City, Utah.
see Utah U. Inst. for the Study of Rate Processes, Salt Lake City.

Institute of Flight Structures, New York.
see Columbia U. Inst. of Flight Structures, New York.

950

Instituto de Investigación de Ciencias Biologicas, Montevideo (Uruguay).

SPECIFICITY AND BIASING OF AROUSAL REACTION HABITUATION, by J. Apelbaum, E. E. Silva and others. [1960] [12]p. incl. diagrs. refs. (AFOSR-TN-60-[illegible]7) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)585 and Rockefeller Foundation) Unclassified

Abstract published in Abstracts of Communications; Twenty-first Internat'l. Cong. of Physiological Sciences, Buenos Aires (Argentina) (Aug. 9-15, 1959), 1960, p. 18.

Also published in Electroencephalog. and Clin. Neurophysiol. Jour., v. 12: 829-840, 1960.

Experiments were performed on cats that carried implanted electrodes and in which reactivity was evaluated by presence of EEG activation in the somatic sensory cortex. As a consequence of having been accustomed to the basic tone, responsiveness of the cats was modified in the sense that effectiveness of test tones near the basic value upon the pitch continuum was reduced in a selective manner. This reduction was manifest in two essential aspects, each suggesting different but complementary conclusions. On their first presentation, sounds removed from the basic value by at least 5 c/sec in 200 were effective; those closer, ineffective. Notwithstanding this restriction, mechanisms mediating EEG arousal exhibited a relatively marked ability for differentiating between dissimilar pitches. In successive series, initially positive tones became ineffectual following a staggered sequence in which values closer to the basic frequency achieved negativity earlier. Hence, the process that neutralized basic and, by generalization, adjacent tones, affected also other values: since ability to remain effective in the course of successive applications augmented as pitch separation from basic value increased, the impediment occurred in a decremental manner. Two features of habituation to tones were stressed: specificity and influence upon subsequent learning processes of similar kind. Both appeared related critically to the linear arrangement of tones upon the pitch scale.

951

Instituto de Investigación de Ciencias Biológicas, Montevideo (Uruguay).

CHRONIC IMPLANTATION OF ELECTRODES FOR SUBCUTANEOUS STIMULATION AND CENTRAL RECORDING, by J. P. Segundo, C. Galeano and others. [1960] [3]p. (AFOSR-TN-60-730) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)585 and Rockefeller Foundation) AD 262124 Unclassified

Also published in Acta Neurol. Latinoamer., v. 6: 203-205, 1960.

A technique is described that enables accurate and coordinated implantation of electrodes both in: (1) Peripheral regions (e.g., subcutaneous tissue of paws): they permit chronic stimulation of the same peripheral locus and at the same time, avoid the unreliable placement and removal of electrodes in each experimental session, and (2) Central nervous areas possessing electrographic responses that exhibit (a) a critical topographical relationship with the excited peripheral locus and/or (b) a marked susceptibility to the effect of anaesthetic drugs currently used during the implantation procedure. (Contractor's abstract)

952

Instituto de Investigación de Ciencias Biológicas, Montevideo (Uruguay).

TONE CESSATION AS CONDITIONED SIGNAL, by J. A.

Sommer-Smith, C. Galeano and others. [1960] [9]p. incl. illus. diagrs. refs. (AFOSR-TN-60-1323) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)585 and Rockefeller Foundation) Unclassified

Also published in Electroencephalog. and Clin. Neurophysiol. Jour., v. 14: 869-877, 1962.

By means of a standard conditioning routine (instrumental or classical), in which reinforcement occurred shortly after the interruption of a very prolonged sound, cats were trained to react specifically to the cessation (CT) of tone and not to its initiation (1T). During a preliminary habituation animals consistently responded more to 1T than to CT. Learned responses to CT exhibited the behavioral and electrographic features of current conditioned reflexes; the EEG arousal effects developed earlier and were more frequent than the behavioral effects. Animals responded preferentially to tone substraction even under conditions of deep sleep. (Contractor's abstract)

953

Instituto de Neurologia, Montevideo (Uruguay).

A PHOTO-OPTIC-ELECTRONIC METHOD FOR THE DETECTION AND STUDY OF EVOKED POTENTIALS, by P. Handler, A. Vanzulli and others. [1960] [11]p. incl. diagrs. refs. (AFOSR-TN-60-1427) (AF-AFOSR 60-14) AD 258910 Unclassified

Also published in Acta Neurol. Latinoamer., v. 6: 163-173, 1960.

A description is given of a method of detecting EEG evoked potentials based on the averaging of potentials with an identical delay as regards the stimulus. Stimulus-synchronized, EEG brightness-modulated sweeps were elicited, photographed, and arranged one underneath the other. A photometric analysis was subsequently performed by means of a flying line derived from a CRO (Dupont 322) spot, focussed upon the film by means of an optical system, a photocell picking up the light modified by the average transparency of the vertical column focussed at every moment by the flying line. The photocell is fed by the alternating tension of the mains, its current being thus likewise alternating and modulated by the light incidence on the photocathode. This current is amplified on the AC amplifier of an electroencephalograph and is subsequently demodulated and directly recorded on the same apparatus. Details of other application of this apparatus are also given.

954

Instituto de Neurologia, Montevideo (Uruguay).

EVOKED RESPONSES IN MAN. I. PHOTIC RESPONSES, by A. Vanzulli, J. Bogacz and others. [1960] [13]p. incl. diagrs. table, refs. (AFOSR-1167) (AF-AFOSR 60-14) Unclassified

Also published in Acta Neurol. Latinoamer., v. 6: 219-231, 1960.

It is shown that by utilizing detection methods of varying complexity it is possible to record evoked potentials in man, from the scalp. The study, conducted on 102 adults during the waking state with eyes opened or closed and 16 subjects naturally sleeping, shows that visual evoked responses (VER) in the awake man are of a polyrhythmic. high latency complex of an amplitude equal to or slightly larger than background rhythm. The study included observations of the various responses provoked by modification in the attentional state during wakefulness and by the changes in the characteristics of the stimulus. During natural sleep the observation was made of an increase of visual evoked response ' tency and an enhancement in the amplitude of its positive waves. A discussion was conducted of the role of the specific visual pathway and of the unspecific afferent systems in the determination of VER.

955

Instituto de Neurologia, Montevideo (Uruguay).

EVOKED RESPONSES IN MAN. II. HABITUATION OF VISUAL EVOKED RESPONSE, by J. Bogacz, A. Vanzulli and others. [1960] [10]p. incl. diagrs. refs. (AFOSR-1168) (AF-AFOSR 60-14) Unclassified

Also published in Acta Neurol. Latinoamer., v. 6: 353-362, 1960.

In 92 experiments a study was conducted of visual response changes during habituation to continuous flicker stimulation. Visual evoked response was detected from scalp by an integration method. The main visual evoked response changes were reduction of amplitude or disappearance of all its components, particularly of the latter, inconstant increase of latency, and tendency to confinement to the occipital region. The foregoing changes assume the form of waxing and waning but with a constant tendency toward decline. In multiple occasions there developed an afterdischarge set up by a synchronization of the background rhythm. In natural sleep visual evoked response changes similar to those seen during wakefulness were observed. Hence, the habituation process is also expressed during light sleep. (Contractor's abstract)

956

Instituto de Neurologia, Montevideo (Uruguay).

A SIMPLE METHOD FOR MAGNETIC TAPE RECORDING OF BIOELECTRIC POTENTIALS, by P. Handler and E. Garcia-Austt. [1960] [3]p. incl. diagrs. (AFOSR-2741) (AF-AFOSR 60-14) Unclassified

Also published in Electroencephalog. and Clin. Neurophysiol. Jour., v. 13: 800-802, 1961.

A system is described which it is hoped will help overcome the difficulties encountered when shifting a signal spectrum into a recordable frequency band for recording. It includes a pre-amplification by means of one channel of a Grass IIID Electroencephalograph, a modulator with a 1NS4 germanium diode biased with the +3 terminal avilable at the control panel of the IIID. The recorder employed was a 7 1/2 in./sec full track Ampex model 601. The carrier generator was a Grass S4. To obtain the frequency characteristic required, a condenser of about 500 $_{p}$F was connected in series between the modulator and the recorder.

957

Instituto de Quimica Fisica, Madrid (Spain).

KINETICS OF THE SULPHURATION OF METALLIC SURFACES, by J. Llopis, J. M. Gamboa, and L. Arizmendi. Final rept. May 1960, 77p. incl. diagrs. tables, refs. (AFOSR-TR-60-73) (AF 61(514)1329) AD 242269; PB 150334 Unclassified

Studies were made of the surface reaction of Cu and Pt with aqueous solutions of labelled thiourea. A tarnishing reaction occurred at the surface of Cu, forming a film of CuS. The reaction with Pt formed a few monolayers. The surface reaction of Cu with solutions of diphenylthiourea in xylene yielded coherent films, showing interference colors. The reactivity in this case was lower than that of thiourea in aqueous solution, and the kinetic law of the film growth was linear with time. The surface reaction of Cu with aqueous solutions of methylthicurea yielded coherent tarnishing films, indicating the influence of O_2 on the kinetics of the reaction. The surface reaction of Cu with aqueous solutions of sodium polysulfide at 60°, 40°, and 25°C produced coherent films. The results obtained at 17°, 10°, and 0.5°C showed a change in the kinetics. The rate of corrosion was greater at temperatures below 20°C and the films were porous. Diethyl disulfide, dissolved in xylene, did not react with Cu, while diethyl trisulfide in the same conditions did react, forming a film of sulfide on the surface. The films were at first coherent; however, black circular strains soon appeared and the collision rate increased appreciably with time. The reactions of Cu and Ag with benzene solution of S were studied. In the first case, the rate of corrosion was high, taking place by pitting, which produced porous films that easily scaled off. The reaction of Ag was much slower and yielded coherent films showing interference colors. (Contractor's abstract, modified)

958

Instituto de Quimica Fisica, Madrid (Spain).

THE SULPHURATION OF COPPER WITH SOLUTIONS OF DIETHYL POLYSULPHIDES, by J. Llopis, J. M. Gamboa, and L. Arizmendi. [1959] [12]p. incl. illus. diagrs. tables, refs. [AF 61(514)1329] Unclassified

Also published in Electrochim. Acta, v. 3: 83-93, 1960.

Diethyldisulphide, dissolved in dry xlene, does not react with copper, whereas diethyltrisulphids under the same conditions does react, giving up the 3 atoms of sulphur, to form a surface film of sulphide. The rate of film growth is constant, and the experimental activation energy is 17.5 kcal/mol in the range 100-130°C, the only temperatures giving suitable reaction. The sulphide films are at first coherent and show interference colors; however, black circular stains soon appear and the corrosion rate then increases appreciably. The influence of free sulphur in xylene solutions with diethyltrisulphide was studied. The rate of formation of the sulphide film increases with the concentration of sulphur and the films formed are coherent. However, pure solutions of elementary sulphur in xylene produce dull non-coherent deposits, showing no interference colors. (Contractor's abstract)

959

Instituto de Quimica Fisica, Madrid (Spain).

KINETICS AND MECHANISM OF THE DEHYDROGENATION OF ISOPROPYL ALCOHOL ON Cr_2O_3 AND $ZnCr_2O_4$, by J. F. Garcia de la Banda and G. Kremenic Orlandini. Final rept. Dec. 1960, 89p. incl. diagrs. tables, refs. (AFOSR-168) (AF 61(514)1330) AD 252344 Unclassified

The kinetics of isopropyl alcohol dehydrogenation on Cr_2O_3 and $ZnCr_2O_4$ catalysts have been studied at several temperatures in the 350 - 500°C range. The apparent reaction mechanism seems to be the same on both catalysts. It includes 2 equal active centers on which reactant and products obtained are adsorbed. The surface reaction is the reaction rate determining step. It appears that during the reaction both Cr_2O_3 and $ZnCr_2O_4$ are subjected to a p to n inversion in their semi-conductivity type. This promotes abnormal kinetic effects. For Cr_2O_3 p to n inversion has been substantiated by electrical resistance measurements in different atmospheres and in the course of the reaction.

960

Instituto Nacional de Tecnica Aeronautica Esteban Terradas, Madrid (Spain).

SOME CONTRIBUTIONS TO LAMINAR FLAME THEORY, by G. Millán and I. Da Riva. 1960 [23]p. incl. diagrs. (AFOSR-41) (AF 61(052)221) AD 261742 Unclassified

Presented at Second Internat'l. Cong. in Aeronautical Sciences, Zurich (Switzerland), Sept. 12-16, 1960.

Also published in Advances in Aeronaut. Sci., v. 3: 447-464, 1960.

The cases considered in this study and the results obtained are the following: (1) Flame with heat loss localized at the stabilizer. It is shown that the two velocities of Hirschfelder reduce to only one, by means of the choice of the adequate parameter, pointing out the apparent contradiction between Spalding's experimental results and the theoretical conclusions. (2) Flame with distributed heat losses. It is shown that the two velocities of Spalding reduce to only one by varying slightly the boundary conditions at the hot limit, both when an ignition temperature at the cold boundary is assumed as well as when the porous stabilizer of Hirschfelder is used. This result is particularly significant when the activation energy is different from zero, because then such modification is made imperceptible and the lower of both velocities is very small. (3) Finally, as a new cause of disturbance, for the same flame model, the effect of a dilution of the mixture produce by the lateral diffusion of the active species, is considered, obtaining the result that the dilution diminishes the flame velocity, which vanishes for a limit value of the lateral diffusion coefficient. (Contractor's abstract)

961

Instituto Nacional de Tecnica Aeronautica Esteban Terradas, Madrid (Spain).

DISTRIBUTION OF RADICALS IN LAMINAR FLAMES, by G. Millán and I. Da Riva. [1960] [14]p. incl. diagrs. table, refs. [AFOSR-2495] (AF 61(052)221) Unclassified

Also published in Eighth Symposium (Internat'l.) on Combustion, California Inst. of Tech., Pasadena (Aug. 28-Sept. 3, 1960), Baltimore, Williams and Wilkins Co., 1962, p. 398-411. (AFOSR-TR-60-127)

This study shows that it is possible to deduce a completely general criterion for the applicability of the steady-state assumption, based on purely mathematical considerations, in the determination of the distribution of chemical radicals in flames. The reason of such approximations and the development of a procedure of successive approximations from the solution corresponding to the steady-state assumption are also revealed. It is shown that the steady-state assumption implies a first-order approximation to the exact solution of the flame equations. The theory is applied to a mathematical model which preserves the fundamental properties of the flame and offers an easy way of comparing the exact solutions with successive approximations obtained when the proposed method is employed. Finally, the theory is applied to several typical radical reaction laws as well as to the different cases of flames studied by several authors. Normally, in these applications the first two perturbations are sufficient to evaluate the accuracy with which the steady-state assumption enables the concentration of the radicals to be calculated.

962

Instituto Nacional de Tecnica Aeronautica Esteban Terradas, Madrid (Spain).

COMBUSTION OF LIQUID MONOPROPELLANTS AND BIPROPELLANTS IN DROPLETS, by C. S. Tarifa, P. Perez del Notario, and F. G. Moreno. [1960] [22]p. incl. illus. diagrs. refs. (AFOSR-2498) [AF 61(052)221] AD 611608 Unclassified

Also published in Eighth Symposium (Internat'l.) on Combustion, California Inst. of Tech., Pasadena (Aug. 28-Sept. 3, 1960), Baltimore, Williams and Wilkins Co., 1962, p. 1035-1056. (AFOSR-TR-60-127)

Theoretical and experimental results of an investigation on the combustion of monopropellant droplets within an inert atmosphere and on the combustion of bipropellant systems consisting of fuel (oxidizer) droplets within the vapors of an oxidizer (fuel) are shown. For the case of the combustion of monopropellant droplets, results show that the controlling parameter of the process is the dimensionless ratio of the activation energy to the heat of reaction. Solutions obtained for finite droplet radius tend rapidly toward its asymptotic value, provided that the activation energy is not too large. However, when very small droplets are considered, important errors may be introduced by assuming that the reaction rate is infinitely fast. The principal result of the experimental investigations on the combustion of monopropellant droplets is that a certain amount of oxygen is always necessary to obtain combustion of the droplet. The minimum amount of oxygen required to keep combustion decreases considerably as the temperature of the nitrogen-oxygen mixture is raised. For small percentages of oxygen the flames have an almost spherical shape, and the burning rates are of the same order of magnitude that was obtained theoretically.

963

Instituto Nacional de Tecnica Aeronautica Esteban Terradas, Madrid (Spain).

THE INFLUENCE OF CHEMICAL KINETICS ON THE COMBUSTION OF LIQUIDS (Abstract), by C. [S.] Tarifa. [1960] [1]p. (AF 61(052)221) Unclassified

Presented at First AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, General Dynamics Corp., General Atomic Div., San Diego, Calif., Sept. 6-7, 1960. (AFOSR-TN-60-1053; AD 246174)

The influence of chemical kinetics on the combustion of bipropellant droplets is investigated. Assuming that the reaction rate is infinitely fast, results obtained do not depend practically on the pressure and the size of the droplet does not influence the process since both maximum temperature and flame/droplet radius ratio do not depend on the droplet radius. It is shown that the square of the droplet radius is a linear function of time. Results also show that when the pressure on the

droplet radius is small, chemical kinetics influence the process. All results may be expressed as a function of the product $p^{n/2}r_s$, where p is the pressure, r_s is the droplet radius, and n is the overall reaction controlling the process. There exists a minimum value of such product under which an isolated droplet cannot sustain a flame.

964

Iowa State U. [of Science and Tech.] Dept. of Chemistry, Ames.

SOLVENT EFFECTS IN THE REACTIONS OF FREE RADICALS AND ATOMS. VIII. THE PHOTOCHLORINATION OF ARALKYL HYDROCARBONS, by G. A. Russell, D. G. Hendry and others. [1960] 28p. incl. diagr. tables, refs. (AFOSR-TN-60-880) [AF 49(638)678] AD 427957 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2976-2983, Oct. 5, 1963.

In the side-chain photochlorination of aralkyl hydrocarbons, high selectivity is often observed because of complex formation between the aromatic nucleus and the chlorine atom. This complexed chlorine atom displays considerably greater selectivity in hydrogen abstraction reactions than the free chlorine atom. Dilution of aralkyl hydrocarbons by inert noncomplexing solvents destroys the high selectivity often noted in photochlorination. Extrapolation of selectivity data to an infinite dilution of the aralkyl hydrocarbon yields reactivity data toward the free chlorine atom. (Contractor's abstract)

965

Iowa State U. [of Science and Tech. Engineering Experiment Station] Ames.

VIBRATIONAL TRANSITIONS AND THE INTERMOLECULAR POTENTIAL, by R. C. Amme and S. Legvold. [1960] [5]p. incl. diagrs. tables, refs. (AFOSR-TN-60-137) [AF 18(600)1496] AD 246184 Unclassified

Also published in Jour. Chem. Phys., v. 33: 91-95, July 1960.

Temperature-dependence studies of vibrational collision lifetimes by the authors have indicated that the application of the Schwartz, Slawsky, and Herzfeld theory to substituted methane molecules with heavy surface atoms results in repulsive ranges which are shorter than those expected from a Lennard-Jones 6:12-type interaction. It has been shown that the 28:7 potential suggested by Hamann and Lambert for quasi-spherical molecules gives ranges which are in better agreement. Also, experimental relaxation times of $CHClF_2$-argon and $CHClF_2$-helium mixtures have been used to obtain the collision lifetimes for the $CHClF_2$ molecule undergoing either argon or helium collisions. The results can be explained using the SSH theory, if the 6:12 ranges for helium and argon are averaged with the shorter experimental range for $CHClF_2$. (Contractor's abstract)

966

Iowa State U. [of Science and Tech.]. Engineering Experiment Station, Ames.

SOUND DISPERSION IN ETHANE AND 1,1-DIFLUOROETHANE, by L. M. Valley and S. Legvold. [1960] [3]p. incl. diagrs. table. (AFOSR-TN-60-733) [AF 18(600)-1496] AD 246183 Unclassified

Also published in Jour. Chem. Phys., v. 33: 627-629, Aug. 1960.

A method of interpreting data on double dispersion of ultrasound in ethane and 1,1-difluoroethane is presented. Results are compared with those of Lambert and Salter. (Proc. Roy. Soc., v. 253A: 277-288, Nov. 24, 1959)

967

Iowa State U. [of Science and Tech.]. Engineering Experiment Station, Ames.

SOUND DISPERSION IN ETHANE-ETHYLENE MIXTURES AND IN HALO-ETHANE GASES, by L. M. Valley and S. Legvold. [1960] [5]p. incl. diagrs. tables, refs. (AFOSR-TN-60-924) [AF 18(600)1496] Unclassified

Also published in Jour. Chem. Phys., v. 36: 481-485, Jan. 15, 1962.

Sound dispersion is examined in ethane-ethylene mixtures, in 3 halo-ethane gases, and in a C_2H_6—CH_3CHF_2 mixture—all at room temperature. Double dispersion is observed whenever ethane is present and single dispersion for all other gases. The relaxation times and collision lifetimes are reported along with some discussion on the effectiveness of ethane-ethane versus ethane-ethylene collisions. For the halo-ethane gases the exchange mode used should be the lowest mode of "regular" vibration, not the mode of hindered rotation. The free flow of energy that occurs between modes of vibration in the same molecule does not occur between the modes of vibration of 2 different molecules (C_2H_6—CH_3CHF_2) while in collision. (Contractor's abstract)

968

Iowa State U. [of Science and Tech.]. Engineering Experiment Station, Ames.

VIBRATIONAL RELAXATION TIMES FOR GAS MIXTURES, by L. M. Valley and S. Legvold. [1960] [1]p. incl. tables. (AFOSR-TN-60-925) [AF 18(600)-1496] Unclassified

Also published in Phys. Fluids, v. 3: 821, Sept.-Oct. 196

A relationship is derived for the vibrational relaxation times of gas mixtures exhibiting a single dispersion of sound. Existing experimental data are in good accord with the theoretical relation.

969

Iowa State [U. of Science and Tech.]. Engineering Experiment Station, Ames.

TEMPERATURE DEPENDENCE OF SOUND DISPERSION IN HALO-METHANE GASES, by S. Legvold, R. C. Amme, and L. M. Valley. Mar. 1958, 62p. incl. diagrs. tables, refs. (AFOSR-TN-60-1206) (AF 18(600)1496) AD 246239 Unclassified

A presentation of the results of a study on vibrational excitation probabilities as a function of temperature for a number of halogen-substituted methanes over a range of 100 to 300° is made with an interpretation of the results in light of existing theory. The following conclusions are reached: (1) The interferometer used in these studies may be used as an absolute instrument in the determination of relaxation absorption. (2) Inflection frequencies of the velocity dispersion in the methane derivatives studied do not change rapidly with temperature. (3) Series excitation which prevails at room temperature persists as the temperature is increased. (4) The energy excitation theory postulates the existence of a minimum energy of approach which is proportional to the energy of the lowest mode of vibration. The temperature dependence of collision lifetime predicted by theory based on this hypothesis is in wide disagreement with the results of this study. (5) A distinct preference of the Landau-Teller temperature dependence over the exponential T^{-1} dependence is observed. However, the Landau-Teller theory does not account for the peculiar linear dependence of the logarithm of collision lifetimes upon the lowest mode of molecular vibration. Reasonable values for the range of intermolecular forces are obtained from this study.

970

Iowa State U. [of Science and Tech.]. Engineering Experiment Station, Ames.

[HEAT CAPACITY LAG IN HEAVY GASES] by S. Legvoid and L. M. Valley. Final rept. Aug. 1960, 6p. (AFOSR-TR-60-109) (AF 18(600)1496) AD 242859 Unclassified

The achievements of the study on heat capacity lag in heavy gases is presented. The experimental and theoretical conclusions reported in the literature (IOW.62001, Vol. I, item no. 758, Vol. III; and item nos. 965, 966, 967, 968, 969, Vol. IV) are summarized and results given.

971

Iowa State U. of Science and Tech. [Statistical Lab.] Ames.

FITTING THE POISSON BINOMIAL DISTRIBUTION, by R. Shumway and J. Gurland. [1960] [12]p. incl. tables. (AF 49(638)43) Unclassified

Published in Biometrics, v. 16: 522-533, Dec. 1960.

A much easier procedure for obtaining maximum likelihood estimates and computing probabilities in the fitting of the Poisson binomial distribution is given. The maximum likelihood and recurrence relations are rewritten in terms of ratios of Poisson factorial moments and these ratios are tabulated for values of the parameters when n = 2. A simple example is described to illustrate the computational procedure and to show how the labor in fitting may be reduced considerably by using the given tables.

972

Iowa State U. [of Science and Tech.]. [Statistical Lab., Ames.]

SMALL SAMPLE BEHAVIOUR OF CERTAIN TESTS OF THE HYPOTHESIS OF EQUAL MEANS UNDER VARIANCE HETEROGENEITY, by R. S. McCullough, J. Gurland, and L. Rosenberg. [1960] [9]p. incl. diagr. tables, refs. [AF 49(638)43] Unclassified

Published in Biometrika, v. 47: 345-353, Dec. 1960.

By using a finite series representation of the distribution of a certain class of statistics, and by utilizing other techniques presented here, 2 types of statistics are developed for testing the hypothesis of the equality of the means of 2 normal populations using small sample sizes. One type of statistic, called unilateral, effectively controls the size of the test under variance heterogeneity if it is known a priori that the variance of 1 specified population is greater than that of the other. The second type of statistic, called bilateral, controls the size when there is no a priori knowledge of the population variances. Tables are included specifying both types of statistics and giving size and power. (Contractor's abstract)

973

Israel Inst. of Applied Social Research, Jerusalem.

SOME CORRELATES OF THE EMPATHY OF THE WORKERS WITH THE FOREMAN, by U. G. Foa. Jan. 1960 [5]p. incl. tables, refs. (Technical note no. 2) (AFOSR-TN-60-1005) (In cooperation with Bar-Ilan U., Ramat Gan (Israel)) (AF 61(052)121) AD 242272 Unclassified

Also published in Jour. Appl. Psychol., v. 44: 6-10, 1960.

Some findings regarding the ability of the worker to predict the perception of his own foreman are presented. The results suggest that the prediction of the worker is more likely to succeed when the foreman's attention is oriented toward the worker. Success is also more likely when the worker believes that the attention of the foreman is not oriented toward the worker. It is also shown that the characteristics of the perception to be predicted significantly influence the outcome of prediction. Thus, certain perceptions are easier to predict than others. (Contractor's abstract)

974

Israel Inst. of Applied Social Research, Jerusalem.

A CONSTRUCTIVE FORMULA FOR COMMUNALITIES, by L. Guttman. Feb. 1960, 38p. incl. refs. (Technical note no. 4) (AFOSR-TN-60-1006) (In cooperation with Hebrew U., Jerusalem (Israel)) (AF 61(052)121) AD 242268; PB 150360 Unclassified

Let R be a Gramian matrix of order n. The communality problem of factor analysis is to find a real diagonal matrix U such that $R - U^2$ satisfies 2 conditions: (1) that $R - U^2$ be Gramian, and (2) that U be optimal in some sense. A possible reason for the failure to face more squarely the problem of Gramianness may be the difficulty of expressing the former property in a manageable analytical form. The purpose of this paper is to help overcome this difficulty. A rather general formula for constructing matrices U for which $R - U^2$ is always Gramian is provided. The usual procedure is reversed and Gramianness is considered before optimality. The formula is particularly amenable to yielding analytical and computable solutions with respect to optimality criteria related to that of minimal trace. The exceptional sets of communalities not constructable by the formula are believed to be of little practical importance or else can be approached iteratively.

975

Israel Inst. of Applied Social Research, Jerusalem.

A STRUCTURAL THEORY FOR INTERGROUP BELIEFS AND ACTION, by L. Guttman. [1959] [11]p. incl. diagr. tables, refs. (Technical note no. 5) (AFOSR-TN-60-1007) (In cooperation with Hebrew U., Jerusalem (Israel)) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)121 and the Ford Foundation) AD 242273 Unclassified

Also published in Amer. Sociolog. Rev., v. 24: 318-328, June 1959.

The relation of an abstract theory to empirical research is one of the problems tackled by the metatheory of facets. A distinction is made between the structure of the universe of content of a theory and the statistical structure of the corresponding empirical observations. When there is a clear design for the universe, a special metatheory—like the contiguity principle—can be used to predict the statistical structure: the closer 2 variables are semantically, the closer they will be statistically. Three facets (subject's behavior, referent, and referent's intergroup behavior) of 2 elements each suffice to distinguish 8 important subuniverses of intergroup behavior. Differences within each subuniverse are defined by 2 further facets, the variants and the ranges of the respective behaviors. Statistical distances between the subuniverses were predicted to have a certain order structure related to the facet design of the semantic definition of the subuniverses. An approximate simplex order holds among these latter 4 subuniverses, so that the maximum predictability of each is virtually attainable from its immediate neighbor or neighbors alone. To increase the predictability would require enriching the facet design, or placing these behaviors in a larger context.

976

Israel Inst. of Applied Social Research, Jerusalem.

FACET DESIGN AND ANALYSIS OF DATA ON PERSONALITY AND ATTITUDES RELATED TO HUMAN ORGANIZATION, by U. G. Foa and L. Guttman. Technical summary rept. June 1, 1958-May 31, 1960, 34p. incl. tables. (AFOSR-TN-60-1008) (In cooperation with Bar-Ilan U., Ramat Gan and Hebrew U., Jerusalem (Israel)) (AF 61(052)121) AD 242581 Unclassified

A basic role of facets is that of classifying concepts. Focusing in particular on the problem of classifying attitudinal data led to a generalized 3 facet structure for a large variety of empirical research and theory. The 3 generalized facets are the domain, criteria and ranges respectively of the data to be studied. The problem of ordering people or groups according to their attitudes, and the converse problem of ordering attitudinal variables for groups, were illuminated in a most fundamental fashion by the generalized 3 facet design. Convergences in the types of social facets used in the study of interpersonal behavior were studied most intensively, with most encouraging results. The dynamic formulas for dyadic facets, the communality problem, and the linear algebra associated with the contiguity hypothesis of facet theory are summarized briefly. (Contractor's abstract)

977

[Israel Inst. of Applied Social Research, Jerusalem].

CONVERGENCES IN THE ANALYSIS OF THE STRUCTURE OF INTERPERSONAL BEHAVIOR, by U. G. Foa. [1960] [13]p. incl. tables, refs. (AFOSR-TN-60-1125) (In cooperation with Bar-Ilan U., Ramat Gan (Israel)) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)121 and National Institute of Mental Health under M-2669) Unclassified

Findings regarding the structure of interpersonal behavior, reported by various investigators and dealing with different types of groups and ratings, are reviewed. These findings suggest a circumplex structure around the 2 orthogonal axes of Dominance-Submission and Love-Hostility. It is shown that 2 axes are sufficient for describing the empirical results, but not for explaining them. A new, fuller, facet structure is developed to account for the empirical findings. Some characteristics and implications of this structure are examined. (Contractor's abstract)

978

Israel Inst. of Applied Social Research, Jerusalem.

SOME DEVELOPMENTS OF A STUDY OF INDUSTRIAL RELATIONS IN ISRAEL, by U. G. Foa. Aug. 1959, 17p. incl. refs. (Technical note no. 6) (AFOSR-TN-60-1423) (In cooperation with Bar-Ilan U., Ramat Gan (Israel)) (AF 61(052)121) AD 262106 Unclassified

Presented at Fourth Sociological Cong., Stresa (Italy), Sept. 1959.

Also published in Darshana, v. 1, Jan. 1961.

The development of a program of research in industrial relations in Israel is described against the changing sociological and ideological background of an industry in rapid expansion. Three stages of the program are considered: (1) morale surveys; (2) the investigation of the foreman-worker relation; and (3) the development of a dynamic theory of interpersonal relations. The substantive, methodological and applied problems encountered at each stage and the attempted solutions are briefly described. It is also shown that a continuous line of development runs through the various stages. Each successive step was indeed stimulated by the problems and the findings that preceded it. This account has been motivated by the hope that the results obtained may prove useful to other countries and in particular to those areas where the possibility of industrial development depends on the absorption into industry of large masses of unskilled manpower, trained in patterns of living different from those of an industrial culture. (Contractor's abstract)

Israel Inst. of Tech., Haifa.
see Technion - Israel Inst. of Tech., Haifa.

979

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

MAGNETIC VISCOSITY AND ANNEALING IN MAGNETIC FIELD. THEORY OF THE MAGNETIC VISCOSITY DUE TO SOLUTE ATOM PAIRS, by G. Biorci, A. Ferro, and G. Montalenti. Nov. 1959 [106]p. incl. diagrs. refs. (Technical note no. 3a) (AFOSR-TN-60-193) (AF 61(514)1331) AD 232369; PB 145861 Unclassified

The diffusion viscosity due to the rotation of couples of solute atoms in alloys was studied. The relationship between annealing of alloys in a magnetic field and magnetic aftereffect was investigated. A theory was developed for the magnetic viscosity due to rotation of couples of solute atoms as an extension of the Néel theory of magnetic viscosity due to interstitial atoms. The theory was tested experimentally with Fe-Si and Fe-Al alloys. In Fe-Si alloys the aftereffect occurs with practically only one time constant at about 400°C. The max value of the viscosity field appeared to be roughly proportional to the square of the Si concentration, i.e., to the number of couples of Si atoms. In Fe-Al alloys, the max number of couples of Al atoms is found for an atomic concentration of somewhat lower than 20%. When the concentration is 25%, the number of Al-Al couples is very small because the structure is ordered. The conclusion is that the existence of a viscosity field due to the rotation of couples of solute atoms can be foreseen in theory and is proven by experience. The relationships between annealing in a magnetic field and the diffusion viscosity were studied with Fe containing a definite amount of interstitial atoms, and with Fe-Si and Fe-Al alloys of various concentrations. On cooling an Fe specimen with interstitial carbon in solution from -16° to 70°C, the loop becomes more square. The same results are observed when Fe-Si and Fe-Al are cooled in field from 600°C.

980

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

EFFECT OF NEUTRON BOMBARDMENT ON THE MAGNETIC PROPERTIES OF IRON AND NICKEL OF VERY HIGH PERMEABILITY. II, by G. Biorci, A. Ferro, and G. Montalenti. Dec. 1959 [8]p. incl. diagrs. (Technical note no. 2b) (AFOSR-TN-60-309) (AF 51(514)1331) AD 234585; PB 146436 Unclassified

Also published in part in Jour. Appl. Phys., v. 31: 2046-2047, Nov. 1960. (Title varies)

Rings of Fe and Ni of high purity were annealed for 18 hr in H at temperatures near the melting point. The

max relative permeability was about 150,000 for Fe and 5000 for Ni. The specimens were irradiated at room temperature with fast neutrons (> 1 mev) at dosages of 4×10^{17} and 1.2×10^{18} n/sq cm; the total integrated flux (thermal plus intermediate) was 2×10^{18} and 1.2×10^{19} n/sq cm for Fe and Ni, respectively. No appreciable change was observed in Ni after irradiation, owing to its poor magnetic properties. A definite decrease in the max permeability and a small increase in coercive force, from 2.5 to 3 A/m, were observed in Fe. Since the permeability and coercive force depend mainly on defects which have a size of the order of the Bloch wall thickness (10^3 A), the results were interpreted as evidence that fast neutron irradiation at room temperature produces large crystal defects. (Contractor's abstract)

981

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

INTERNAL FRICTION OF FeAl ALLOYS DUE TO SOLUTE ATOM PAIRS. REMARKS ON THE THEORY OF THE EFFECT, by G. Biorci, A. Ferro, and G. Montalenti. Jan. 1960 [55]p. incl. diagrs. tables, refs. (Technical note no. 4a) (AFOSR-TN-60-495) (AF 61-(514)1331) AD 236777; PB 147501 Unclassified

The internal friction due to directional short-range order is studied in Fe-Al alloys. At the ·ency approx 1 cps the effect appears at about 510 C with a relaxation time corresponding to a process of substitutional diffusion. The intensity of the effect increased rapidly for concentration above 10%, and then decreased to low values in the region of Fe_3Al, where the order occurred. The curve of the intensity of the effect as a function of concentration was, with fairly good agreement, proportional to the number of solute Al pairs, as deduced from x-ray results of Bradley and Jay. However, some deviation from ideality seemed to be present also at low concentrations. After a critical survey of the present status of the theories of the effect, a quantitative theory has been developed on the basis of Zener hypothesis, according to which the couples of solute atoms deform the lattice anisotropically. The experimental results are in good agreement with this theory. (Contractor's abstract)

982

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

EFFECT OF NEUTRON BOMBARDMENT ON THE MAGNETIC PROPERTIES OF IRON AND NICKEL OF VERY HIGH PERMEABILITY. III, by G. Biorci, A. Ferro, and G. Montalenti. Final rept. Feb. 1960 [65]p. incl. illus. diagrs. refs. (Technical rept. no. 3b) (AFOSR-TR-60-66) (AF 61(514)1331) AD 236778; PB 147502 Unclassified

Ring specimens of Cioffi-type Fe and very pure Ni were prepared, and their magnetic properties measured before and after irradiation by fast neutrons. No remarkable variation was noticed in Ni. At low fields the Fe samples show a remarkable increase of coercive force and a relevant decrease (about 30%) of max permeability. The theoretical interpretations of the results are discussed, and it is concluded that the irradiation produces defects (stable at room temperature) whose size or range of influence are of the order of, or larger than, 1000A.

983

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

MAGNETIC AFTER-EFFECT IN IRON DUE TO MOTION OF DISLOCATIONS, by G. Biorci, A. Ferro, and G. Montalenti. [1960] [5]p. incl. diagrs. table, refs. [AF 61(514)1331] Unclassified

Published in Phys. Rev., v. 119: 653-657, July 15, 1960.

The magnetic after-effect in iron at high temperatures due to motion of dislocations is investigated. The specimens, consisting of a few large crystals, are examined, some after a careful annealing and some after a small plastic deformation. The intensity of the after-effect is measured as the horizontal displacement (viscosity field) between two magnetization curves: one taken immediately after demagnetization, and the other taken a long time later. On annealed Armco iron the magnetic viscosity begins to appear above 320°C, reaching 0.3 amp-turn/m at about 450°C. On the other hand, in cold worked specimens the viscosity field is appreciably larger and is already observable below 200°C. Similar results are obtained on high-purity electrolytic iron. Comparison with the relaxation of elastic modulus, occurring in the same temperature range, seems to confirm that the observed magnetic viscosity is due to dislocation motion. An interpretation of the phenomenon, on the basis of the Vicena theory concerning the dependence of the coercive force on the dislocation density, is given. (Contractor's abstract)

984

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

MAGNETIC VISCOSITY AND ANNEALING IN MAGNETIC FIELD, by G. Biorci, A. Ferro, and G. Montalenti. [1960] [12]p. incl. diagrs. refs. (AF 61(514)1331) Unclassified

Published in Nuovo Cimento, Series X, v. 18: 229-240, Oct. 16, 1960.

It is shown that a sufficient, but not necessary condition,

such as a magnetic material exhibits magnetic annealing, is that it presents also, in a proper temperature range, diffusion magnetic viscosity. Besides, if H_t is the max value of the viscosity field, the energy H_tJ_s is nearly equal to the anisotropy energy K_u induced by annealing in a magnetic field, at least for measurements performed at the same temperature. It is also shown that the anomalies of specific heat, associated with the process of annealing, are so small that they cannot be observed experimentally. The experimental verifications are made on iron containing interstitial carbon. The values of the energy H_tJ_s, obtained from the measure of the max value of the viscosity field, are lower than, but of the same order of magnetude as those of the induced anisotropy constant, measured directly, Considering the poor accuracy with which K_u could be determined, the agreement obtained can be considered satisfactory. (Contractor's abstract)

985

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

MAGNETIC VISCOSITY DUE TO SOLUTE ATOM PAIRS. PART I. THEORY OF THE EFFECT, by G. Biorci, A. Ferro, and G. Montalenti. [1960] [5]p. incl. diagrs. refs. [AF 61(514)1331] Unclassified

Published in Jour. Appl. Phys., v. 31: 2121-2125, Dec. 1960.

It is shown that solute atom pairs in ferromagnetic alloys, as well as the interstitial atoms in iron, can give magnetic viscosity. The viscosity field of the alloys vs wall displacement is determined for various crystal structures. The max value of the viscosity field is related to the anisotropy energy induced in the same materials by heat treating in a magnetic field. (Contractor's abstract)

986

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

MAGNETIC VISCOSITY DUE TO SOLUTE ATOM PAIRS. PART II. EXPERIMENTAL RESULTS, by G. Biorci, A. Ferro, and G. Montalenti. [1960] [6]p. incl. diagrs. refs. [AF 61(514)1331] Unclassified

Published in Jour. Appl. Phys., v. 32: 630-635, Apr. 1961.

The theory of magnetic viscosity due to solute atom pairs has been verified on several bcc alloys. The results on Fe-Si alloys with Si content up to 6% wt show that solute atom pairs give magnetic viscosity. If the strong effect of the temperature is taken into account, the induced anisotropy energy deduced from the viscosity field can be considered in agreement with the value measured directly from the magnetization curves. The results on a series of Fe-Al alloys up to 25 at. % Al, where order occurs, further confirm the theory. The viscosity field is, with reasonable agreement, proportional to the number of solute atom pairs, as deduced from studies on ordering of the alloy and from internal friction resulting from corresponding stress-induced ordering. (Contractor's abstract)

987

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

PART A: GENERALIZATION OF THE THEORY OF THE ISOTHERMAL BLEACHING OF F-CENTERS IN X-RAYED ALKALI HALIDES, by G. Bonfiglioli, P. Brovetto, and C. Cortese. PART B: ELECTRON MICROSCOPY EXAMINATION OF TRACKS OF FISSION PRODUCTS IN MICA CRYSTALS, by G. Bonfiglioli, A. Ferro, and A. Mojoni. Final rept. Mar. 1960 [39]p. incl. illus. diagrs. tables. (AFOSR-TR-60-67) (AF 61(514)-1333) AD 236779; PB 147500 Unclassified

Part A is intended to complete a previous Technical Note no. 3d (see item no. 769, Vol. III). It gives calculations developed in a more general way; an iteration procedure to improve the accuracy of the solution; the solution used in comparing theory to experiment is justified, showing that it does not change appreciably after a further iteration step. Part B deals with some experiments intended to clear the information which electron microscopy could offer in problems concerning the effect of fast particle irradiation of non-metallic crystals. The preliminary results are: The tracks are essentially cylindrical thermal spikes of a diam consistent with the theoretical estimates. The peculiar dashed aspect of some tracks is discussed and related to interference contrast effects or possibly incipient annealing.

988

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

[MICROGRAPHIC STUDY OF THE SURFACES OF SEMICONDUCTORS FOR USE IN ELECTRONICS] Esame micrografico della superficie di semiconduttori per uso elettronico, by A. Mojoni and G. Bonfiglioli. [1959] [6]p. incl. illus. tables. (AFOSR-4065) (AF 61(514)1333) Unclassified

Also published in Rend. A.E.I. (Venice), v. 206: 1-6, Sept.-Oct. 1959.

Observations carried out on samples of various types of monocrystalline Ge for electronic usage are described. The degree of structural perfection is controlled by the etch pit method. The techniques used are described. Numerous micrographs are illustrated and discussed.

989

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

REMARKS ABOUT THE INTERPRETATION OF THERMOLUMINESCENCE, by G. Bonfiglioli, P. Brovetto, and C. Cortese. [1960] 6p. incl. refs. (Technical note no. 1) (AFOSR-TN-60-1143) (AF 61(052)328) AD 244399 Unclassified

Criticism has been made by a series of papers (see Phys. Rev., v. 116: 1081, 1959; v. 117: 408, 1960; and v. 117: 416, 1960) against the contractor's interpretation of the thermoluminescence of x-rayed alkali halides (see item nos. IEN.02:002 and IEN.02:0C3, Vol. II). This is due to misunderstanding. A summary of the contractor's point of view is then given.

990

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

EFFECT OF X-RAY COLORING ON ADDITIVELY COLORED ALKALI HALIDES, by G. Bonfiglioli, P. Brovetto, and C. Cortese. [1960] [20]p. incl. diagrs. refs. (Technical note no. 2) (AFOSR-111) (AF 61(052)-328) AD 252837; PB 171273 Unclassified

Also published in Proc. Internat'l. Conf. on Color Centers and Crystal Luminescence, Turin (Italy) (Sept. 8-12, 1960), Turin, Litografia E. Gili, 1961, p. 55-63. (AFOSR-982)

Previous work on thermoluminescence of x-rayed NaCl above room temperature and complementary investigations on other alkali halides lead to propose a definite mechanism for this kind of thermoluminescence. In the present analysis, the approach to saturation shown by the curves describing the F centers formation under irradiation was made to see whether the saturation could be caused by the same recombinations which produce thermoluminescence. An experiment was performed artificially altering the recombination term and comparing the curves of F centers formation obtained by irradiating a pure crystal of KI and a KI crystal already containing V centers by stoichiometric excess of I_2. The results of the various spectrophotometric measurements performed show that saturation is obtained much sooner and at a much lower level when excess V centers are present, and allow an estimate of the value of the recombination term.

991

Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy).

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON COLOR CENTERS AND CRYSTAL LUMINESCENCE, Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy) (Sept. 8-12, 1960), ed. by G. Bonfiglioli. Turin, Litografia E. Gili, 1961 [310]p. incl. illus. diagrs. tables, refs. (AFOSR-982) [AF 61(052)-328] AD 262095 Unclassified

Twenty-five papers were presented at the conference on color centers and crystal luminescence. Eleven countries were represented by the 49 participants. Some of the specific topics were: (1) the Varley mechanism; (2) temperature effects on color centers; (3) defect formation; (4) thermoluminescence; (5) x-ray effects; (6) electroluminescence; and (7) studies on alkali halides.

992

Istituto Elettrotecnico Nazionale ["Galileo Ferraris"], Turin (Italy).

ORIGIN OF THE "FIRST-ORDER STRUCTURE" OF CP4-ETCHED Ge SURFACES, by G. Bonfiglioli, A. Ferro, and A. Mojoni. [1959] [3]p. incl. illus. diagr. (AFOSR-J29) [AF 61(052)328] AD 297151 Unclassified

Also published in Jour. Appl. Phys., v. 31: 684-686, Apr. 1960.

The results of examinations of surfaces of CP4-etched Ge are briefly reported. The origin of the so-called "first-order structure" observed on the micrographs is discussed. It is shown that while etching proceeds, the ending points of some dislocations are reached, or some of them become passivated. In both cases, the etch pits no longer grow and their traces give origin to the first-order structure. (Contractor's abstract)

993

Istituto Nazionale di Ottica, Florence (Italy).

SPACE VERSUS TIME DISTRIBUTIONS OF CHROMATIC STIMULI, by A. Fiorentini and L. Ronchi. [1957] [15]p. incl. diagrs. tables, refs. (AF 61(514)634-C) Unclassified

Published in Visual Problems of Colour: A Symposium, National Physical Laboratory, Teddington (Gt. Brit.) (Sept. 23-25, 1957), London, Her Majesty's Stationery Office, v. 2: 399-414, 1958.

The procedures used to study the effect of a time variation of the stimulus intensity by the electroretinographic method (ERG) and psychophysical experiments are described. The main result of the ERG experiments seems to be that a white or green stimulus with a low time gradient of luminance is more effective than a rectangular stimulus. This does not occur with blue light. Very similar results are obtained with intermittent stimulations of different shapes. The ERG results refer to the scotopic mechanism while the psychophysical results probably involve both scotopic and photopic mechanisms. Tests on vision of a "linear gradient of color" and of its

discontinuities, show that the mechanism responsible for the Mach band is not effective with only color variation stimulus. This seems to agree with the fact revealed by ERG studies that a slow variation of the stimulus wavelength does not produce electrical response, if the stimulus intensity is constant.

994

Istituto Nazionale di Ottica, Florence (Italy).

ON THE FACTORS WHICH AFFECT THE CONTRAST ENHANCEMENT IN A FIGURE WITH "QUASI PERCEPTIVE CONTOURS" AND A PRACTICAL APPLICATION OF SUCH A FIGURE, by L. Ronchi and G. F. Mori. [1959] [13]p. incl. diagrs. refs. (AFOSR-TN-60-314) (AF 61(052)80) AD 234218 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 14: 495-508, Sept.-Oct. 1959.

Factors that are responsible for the contrast enhancement that occurs when the surface of the enclosed triangle in quasi perceptive contours seems to be brighter than the background are examined. Practical application of the phenomena are suggested. It is stated that simultaneous contrast and cues about the border of the triangle are factors. Luminance and viewing angle are examined and analyzed. The role of the figure of the same type in the visual field is analyzed and found to improve the perception of a small patch darker than the background, situated in the enclosed portion of the figure.

995

Istituto Nazionale di Ottica, Florence (Italy).

SOME COMPARISONS BETWEEN THE RECOVERY AFTER GREEN PRE-ADAPTATION AND THE RECOVERY AFTER BLUE-GREEN PRE-ADAPTATION, by G. Venturi and G. Salvi. [1960] [5]p. incl. diagrs. (AFOSR-TN-60-1009) (AF 61(052)80) AD 242274 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 15: 85-89, Jan.-Feb. 1960.

The addition of blue light to a green pre-adapting stimulus does not seem to delay the course of subsequent dark-adaptation. More precisely, for some subjects this adding up is quite uneffective, that is, the dark-adaptation curve coincides with the curve after blue adaptation. For other subjects, the threshold after blue-green adaptation is lower than the threshold after green adaptation, for a given value of the time in dark. The loss in efficiency of the blue-green pre-adapting field might be explained in terms of neural interaction. (Contractor's abstract)

996

Istituto Nazionale di Ottica, Florence (Italy).

ON A POSSIBLE IMPROVEMENT OF CONTRAST PERCEPTION BY MEANS OF A SYSTEM WHICH CORRECTS THE CHROMATIC ABERRATION OF THE EYE, by L. Ronchi and G. T. di Francia. [1959] [10]p. incl. diagrs. table, refs. (AFOSR-TN-60-1010) (AF 61(052)-80) AD 242275 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 14: 619-626, Nov.-Dec. 1959.

Experiments were performed on the readability of printed letters to help clarify the phenomenon of chromatic aberration. It is found that the correction of chromatic aberration improves the visibility in conditions where the contrast is low and the letters are broad. However, the correction is uneffected when resolution is complicated by border interference effects.

997

Istituto Nazionale di Ottica, Florence (Italy).

SPEED OF READING AS A FUNCTION OF THE ORIENTATION OF THE TEST. I. SUPRATHRESHOLD CONDITIONS FOR SIZE AND ILLUMINATION, by L. Ronchi and G. F. Mori. [1960] [7]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1011) (AF 61(052)80) AD 242276 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 15: 46-52, Jan.-Feb. 1960.

The time t_1 required for reading a signal presented in orientation other than normal is found to be greater than the time t_0 required for reading the same signal when presented with 0° inclination. The ratio t_1/t_0 is found to tend asymptotically towards a limiting value which, in this case, is slightly greater than 3. When a small value of the ratio t_1/t_0 is needed, the signal must consist of either a short word or a symbol. (Contractor's abstract)

998

Istituto Nazionale di Ottica, Florence (Italy).

ENHANCED CONTRAST OF AN INDEFINITELY CONTOURED OBJECT BY MOVEMENT OR INTERMITTENT ILLUMINATION, by M. Bittini, A. M. Ercoles and others. [1959] [23]p. incl. diagrs. refs. (AFOSR-TN-60-1012) (AF 61(052)80) AD 242277 Unclassified

Presented at meeting of the Aeromed. Assoc., Los Angeles, Calif., Apr. 27-29, 1959.

Also published in Atti Fondazione G. Ronchi, v. 15: 62-84, Jan.-Feb. 1960.

The effects of motion upon vision are discussed. The so-called Mach bands, which are responsible for a subjective sharpening of the vision of a blurred contour, were found to become more conspicuous by a slow oscillatory movement of the observed object. The results are discussed in terms of retinal inhibitory mechanisms. Some effects of intermittent illumination upon vision are also discussed. The perception of contrast, in extrafoveal vision, at mesopic and scotopic levels, under steady illumination, is compared to the perception of contrast under pulsating illumination. Further, the effects produced by sequences of triangular and rectangular pulses respectively are compared. The findings are discussed in terms of retinal duality and also the role played by psychological factors is taken into account. An electrical parallel is suggested which might explain, at least partially, the observed effects.

999

Istituto Nazionale di Ottica, Florence (Italy).

GREEN AND BLUE ELECTRORETINOGRAMS AT LOW LUMINANCES, by M. Bittini and L. Ronchi. [1960] [9]p. incl. diagrs. table, refs. (AFOSR-TN-60-1013) (AF 61(052)80) AD 242278 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 15: 53-61, Jan.-Feb. 1960.

The curve obtained by plotting the height of the b-wave against log luminance, shows a complicated behavior when the luminance drops below the value which elicits the 100 microvolts response. The series of the reported dips and humps seem to reflect the disunity of the retinal receptors. (Contractor's abstract)

1000

Istituto Nazionale di Ottica, Florence (Italy).

A METHOD FOR INCREASING THE EFFECTIVENESS OF BRIEF SIGNALS BRIGHTER THAN THE BACKGROUND, by M. Bittini. [1959] [8]p. incl. diagrs. refs. (AFOSR-TN-60-1014) (AF 61(052)80) AD 242279 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 14: 611-618, Nov.-Dec. 1959.

The threshold illumination from a stimulus spot subtending 12 min visual angle and lasting 60 msec was measured when the stimulus was presented either in the dark or against an illuminated background. Each stimulus (either blue or green) was seen against a background of the same color, and was brighter than the background itself. A comparison was made between the threshold data obtained with a rectangular stimulus and those obtained with a triangular stimulus respectively, the 2 stimuli having equal energy, equal duration and different time distribution luminance. Many observations performed by 2 well trained subjects seem to show that the effectiveness of a signal is greater in the case of the triangular time luminance distribution than in the case of the rectangular distribution. This affect is tested for green but not for blue light, when the luminance of the background ranges within certain limits. (Contractor's abstract)

1001

Istituto Nazionale di Ottica, Florence (Italy).

ON THE FACTORS WHICH AFFECT THE PERFORMANCE OF A RADAR OPERATOR. I. SPEED OF READING AND PULSATING LIGHT AT DIFFERENT LUMINANCES, by F. Mori and L. Ronchi. [1960] [14]p. incl. diagrs. refs. (AFOSR-TN-60-1299) (AF 61(052)80) AD 246161 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 15: 138-151, Mar.-Apr. 1960.

The incomplete (either dark- or light-) adaptation of the periphery is found to affect the speed of reading relative to a foveally viewed test, suprathreshold for both size and illumination. The result should be taken into account by radar operators. It is known that, for avoiding the impairment of visibility, the radar operator must be adapted to the luminance of the screen. An analogous condition is now required if the impairment in speed of reading has to be avoided, even in suprathreshold conditions. Now, the luminance of a radar screen is well defined only in the case of long memory tubes and in peculiar environmental conditions, otherwise, the operator is presented with a pulsating stimulus. In this latter case, the speed of reading is found to vary as a function of the frequency of interruption at high and at low levels, respectively, but not at intermediate levels, in the range considered. The trouble observed at higher levels can be minimized by the aid of an illuminated surrounding. The observed effects are discussed in terms of central interactions. (Contractor's abstract)

1002

Istituto Nazionale di Ottica, Florence (Italy).

NON UNIFORM ILLUMINATION AND READING TIME, by M. Conticelli and L. Ronchi. [1960] [12]p. incl. illus. diagrs. refs. (AFOSR-TN-60-1300) (AF 61(052)80) AD 246901 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 15: 369-380, July-Aug. 1960.

When a pair of glasses like those described in the text are placed in front of the eyes, the speed of reading a test containing isolated low-contrasting figures is found to be increased with respect to the case of uniform illumination, provided the luminance is made to vary in

the range where speed of reading is affected by luminance itself. (Contractor's abstract)

1003

Istituto Nazionale di Ottica, Florence (Italy).

ELECTRORETINOGRAPHIC RECORDS IN RESPONSE TO LOW-INTENSITY AND SHORT DURATION STIMULI, by M. Bittini. [1960] [4]p. incl. diagrs. (AFOSR-TN-60-1326) (AF 61(052)80) AD 253830 Unclassified

Presented at the Jornadas Mediterraneas de Optica, Madrid (Spain), May 5-7, 1960.

Also published in Atti Fondazione G. Ronchi, v. 15: 260-263, May-June 1960.

Previous experiments revealed the presence of dips and humps in the intensity curve obtained by plotting the height of the scotopic b-wave against luminance. These events are now found to disappear if the duration of the stimulus drops below a certain value (say 30 msec). Such a result is discussed in terms of retinal interactions. (Contractor's abstract)

1004

Istituto Nazionale di Ottica, Florence (Italy).

ON THE RECOVERY OF SENSITIVITY SUBSEQUENT TO EITHER WHITE OR YELLOW GLARE, by A. M. Ercoles. [1960] [8]p. incl. diagrs. refs. (AFOSR-TN-60-1327) (AF 61(052)80) AD 253831 Unclassified

Presented at the Jornadas Mediterraneas de Optica, Madrid (Spain), May 5-7, 1960.

Also published in Atti Fondazione G. Ronchi, v. 15: 264-271, May-June 1960.

The recovery following white glare is compared with the recovery after yellow glare, for different durations of the glare itself. If the luminance of the glaring source exceeds, say 12×10^4 nits, the subsequent recoveries, in the two said cases, do not differ substantially from one another, in spite of the differences in both intensity and color. At lower luminances, for one observer the recovery after white glare is found to be equal to the recovery after yellow glare of equal intensity, or, in other words, no effect properly due to color is found. For the other subject, on the other hand, the recovery subsequent yellow glare is found to be faster than the recovery after white glare of equal intensity. Such an effect is tested for both white and yellow illuminations of the test observed during the recovery time. The individual differences here tested are discussed in terms of the saturation of retinal mechanisms. (Contractor's abstract)

1005

Istituto Nazionale di Ottica, Florence (Italy).

ON THE FACTORS WHICH AFFECT THE PERFORMANCE OF A RADAR OPERATOR. II. RECOVERY OF CONTRAST SENSITIVITY AFTER PRE-ADAPTATION TO STIMULI OF VARIOUS SPECTRAL COMPOSITIONS, by L. Ronchi. [1960] [11]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1328) (AF 61(052)80) AD 253832 Unclassified

Presented at the Jornadas Mediterraneas de Optica, Madrid (Spain), May 5-7, 1960.

Also published in Atti Fondazione G. Ronchi, v. 15: 272-282, May-June 1960.

The recovery of contrast sensitivity subsequent to the pre-adaptation to a given stimulus is compared with the recovery after pre-adaptation to a stimulus obtained by adding some blue light to the stimulus. By adding blue light to a green stimulus, the effectiveness of the latter is found to be decreased, in that a faster recovery is allowed. The further addition of longer wavelengths, at least in certain amounts does not alter substantially the previously described behavior, but noticeable changes are noticed when the contribution of intermediate wavelengths is minimized, and shorter and longer wavelengths coexist. (Contractor's abstract)

1006

Istituto Nazionale di Ottica, Florence (Italy).

ON THE PERCEPTION OF INCOMPLETE BORDERS, by G. F. Mori and L. Ronchi. [1960] [11]p. incl. diagrs. refs. (AFOSR-TN-60-1329) (AF 61(052)80) AD 253833 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 15: 358-368, July-Aug. 1960.

A number of figures enclosed by incomplete contours (consisting of portions of either contrast borders or demarcation lines) are examined; the observed effects are discussed in terms of spreading of excitation at the retina level. (Contractor's abstract)

1007

Istituto Nazionale di Ottica, Florence (Italy).

A METHOD FOR IMPROVING THE DETECTABILITY OF SMALL PATCHES DARKER THAN THE BACKGROUND, by A. M. Ercoles and L. Ronchi. [1960] [5]p. incl. diagrs. (AFOSR-741) (AF 61(052)80) AD 262263 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 15: 613-617, Nov.-Dec. 1960.

Research concerns the contrast enhancement at the enclosed surface of a figure with quasi perceptive contours. The differential threshold relative to a patch darker than the background is determined both in a uniform field and in a structured field, that is, in a field containing portions of incomplete contrast borders. The size of the patch and the exposure time are taken as variables.

1008

Istituto Nazionale di Ottica, Florence (Italy).

ON THE LINEAR FIT OF THE ELECTRORETINOGRAPHIC INTENSITY CURVE, by M. Bittini. [1960] [4]p. incl. diagrs. table. (AFOSR-742) (AF 61(052)80) AD 258872 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 15: 511-514, Sept.-Oct. 1960.

The best fitting lines for the human electroretinographic intensity function have been evaluated by the least square method. The solutions obtained with lights of different color (green and blue) are compared and discussed. (Contractor's abstract)

1009

Istituto Nazionale de Ottica, Florence (Italy).

UNUSUAL FACTORS INFLUENCING THE ELECTRORETINOGRAPHIC INTENSITY FUNCTION, by F. Mori and L. Ronchi. [1960] [3]p. incl. diagrs. (AFOSR-881) (AF 61(052)80) AD 258169 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 15: 503-510, Sept.-Oct. 1960.

One subject was trained for a number of months to give responses to a series of stimuli of various intensities so arranged as to represent a sequence either increasing or decreasing in intensity. Then he was faced with an altered law of variation of intensity. The ERG's have been found to differ in size in a manner which recalls the successive contrast effect (apart from the fact that the time elapsing between various presentations is now very long). Repetitions are found to minimize the observed effect. The results are discussed in terms of current theories on vision process. (Contractor's abstract)

1010

Istituto Nazionale di Ottica, Florence (Italy).

NEGATIVE ELECTRICAL OFF-RESPONSES OF THE HUMAN RETINA. I. BLUE STIMULATION, by L. Ronchi. [1960] [11]p. incl. diagrs. refs. (AFOSR-882) (AF 61(052)80) AD 258189 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 15: 515-525, Sept.-Oct. 1960.

The light-adapted eye of one subject has been stimulated by negative gradients of luminance and by negative flashes. The behavior of the size of the electrical response, consisting essentially of a negative deflection of the base line, is determined by taking as a variable the adapting luminance. The smallness of the slope of this intensity function is discussed in terms of retinal organization. (Contractor's abstract)

1011

Istituto Nazionale di Ottica, Florence (Italy).

A COMPARISON BETWEEN BLUE AND GREEN NEGATIVE OFF-RESPONSES RECORDED FROM HUMAN EYE, by L. Nicoletti and L. Ronchi. [1960] [8]p. incl. diagrs. tables. (AFOSR-1285) (AF 61(052)80) AD 262268 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 15: 634-641, Nov.-Dec. 1960.

The slope of the intensity function relative to the (negative) blue off-response is found to be greater, in absolute value, than the slope of the green intensity function. Such an effect is discussed in terms of current views on retinal mechanisms. The study of the variability in shape of the off-responses leads to the conclusion that the single response is of little or no meaning at all, for representing a given response situation. Rather, a number of responses are required, from the same subject, and their characteristics should be classified according to a dimorphic model, such as that suggested in the text. (Contractor's abstract)

1012

Istituto Nazionale di Ottica, Florence (Italy).

ON THE INDIVIDUAL DIFFERENCES IN THE RECOVERY AFTER GLARE, by G. Salvi and G. Venturi. [1960] [7]p. incl. diagrs. (AFOSR-1286) (AF 61(052)80) AD 262269 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 15: 642-648, Nov.-Dec. 1960.

The behavior of the recovery time for various durations of glare has been determined by taking as a variable the color of the glaring stimulus (yellow, white, red). The subjects who took part in this experiment were classified according to the color of their iris (qualitatively evaluated), based on the assumption that a correlation exists between the color of the iris and the optical density of the pigment of the macula lutea. The result is that the individuals with dark iris recover earlier after yellow glare than the individuals with light blue iris. In addition, the recovery after yellow glare occurs earlier than the recovery after white glare of equal luminance,

provided the color of the iris is light blue. Such a difference, on the other hand, was not tested for subjects with dark iris. The recovery after red glare does not seem to be correlated with the color of the iris. (Contractor's abstract)

1013

Istituto Nazionale di Ottica, Florence (Italy).

ON THE PERCEPTION OF SIZE IN AMBIENTS OF DIFFERENT COLOR, by M. Conticelli. [1960] [11]p. incl. illus. diagrs. tables. (AFOSR-1287) (AF 61(052)-80) AD 262270 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 15: 595-605, Nov.-Dec. 1960.

The apparent size of an object placed in an ambient with no reference cues (optical tunnel), under red illumination seems to be greater than under blue illumination of equal equivalent luminance, every other thing being equal. The effect, tested by a number (25) of normal and young subjects, is attenuated and even disappears if the experimental set is prolonged over a period of (say) one hr. However, if the experiment is repeated after a few days of rest, the effect is restored. This apparent magnification due to red illumination does not depend on the absolute value of accommodation, and it is interpreted in terms of the ability of the image-producing mechanism to provide differentially characterized stimulus patterns. (Contractor's abstract)

1014

Istituto Nazionale di Ottica, Florence (Italy).

FLUCTUATIONS OF PHYSIOLOGICAL NATURE, AS REVEALED BY DIFFERENTIAL THRESHOLD DETERMINATIONS, AT VARIOUS LUMINANCES OF THE ADAPTING FIELD, by M. Bittini. [1960] [7]p. incl. diagrs. (AFOSR-1288) (AF 61(052)80) AD 262271 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 15: 606-612, Nov.-Dec. 1960.

Detection probability curves, as functions of log luminance of the background were obtained for a green light stimulus (12 min of arc, in angular aperture, located at 7° nasal) superimposed upon a green field. In some experiments the contrast of the patch relative to its background was kept constant, for all the curves obtained, while each curve corresponds to a different exposure time; in other experiments the exposure time was fixed, while the contrast was varied from curve to curve. A comparison between the forms of the curves of the same family or between those of two different families was made. The main result is that a range of the luminance of the adapting field exists where a source of fluctuations affects the threshold data, which does not occur beyond that range. Such a range is tested to coincide with the mesopic range. These fluctuations are supposed to be of physiological nature and due to the particular level of the luminance of the adapting field, involving the transition from rod to cone dominance. (Contractor's abstract)

1015

Istituto Nazionale di Ottica, Florence (Italy).

VISION WITH STABILIZED IMAGES AND INTERMITTENT ILLUMINATION, by A. Fiorentini and A. M. Ercoles. [1960] [16]p. incl. diagrs. tables. (AFOSR-1289) (AF 61(052)80) AD 262272 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 15: 618-633, Nov.-Dec. 1960.

Details of a target imaged at a fixed retinal area, in spite of eye movements, disappear for a fraction of the total observation time. In the present experiment the disappearance time (DT) fraction has been measured under intermittent illumination of a stabilized target (dark vertical line in a bright field) in a range of frequencies from 0.1 to 28 cps. Two flicker conditions have been used: (a) intermittent illumination of the whole target, and (b) intermittent presentation of the dark line on a steadily illuminated field. It has been found that disappearance of the stationary line can be completely prevented by flickering the target (or the line) at a rate of 1 cps. Both lower and higher flicker rates are less effective, and at frequencies equal to or greater than 4 cps the DT fraction has the same value as with steady illumination of equal brightness. By taking into account that at 4 cps there is complete recovery of brightness sensitivity during the dark intervals (the cff in the experiments is of the order of 15-20 cps) the results seem to indicate that the mechanism responsible for visibility of contrast under stationary conditions is slow as compared with the mechanism responsible for brightness sensitivity. (Contractor's abstract)

1016

Istituto Superiore di Sanità, Rome (Italy).

[ACTION OF DIPHENYLDIAZADAMANTANE (1757 IS) ON MONO- AND POLY-SYNAPTIC REFLEXES, ON SPINAL PRIMARY INHIBITION] Azione del difenildiazadamantanolo (1757 IS) sulle vie inibitorie spinali, by V. G. Longo. [1959] [5]p. incl. illus. (AFOSR-TN-60-1404) (AF 61(052)138) AD 246867 Unclassified

Presented at Eleventh Cong. Nazionale Soc. Ital. di Fisiologia, Salsomaggiore (Italy), Oct. 8-10, 1959.

Also published in Boll. Soc. Ital. Biol. Sper., v. 35: 2035-2039, 1959.

The paper reports on the results obtained during the study of the action of 5-7 diphenyl-1-3-diazadamantane-6-01 (1751 IS) on mono- and polysynaptic reflexes, on

spinal primary inhibition and on the spontaneous and evoked discharge of single interneurones at the level of the spinal cord. The work was carried out on spinal anaesthetized cats. Augmentation of the polysynaptic reflex was noticed after the administration of 0.1 - 0.2 mg/kg of the drug. The inhibition exerted by an afferent volley to the quadriceps nerve on the monosynaptic response due to stimulation of the biceps-semiten dinosus nerve is abolished after the injection of subconvulsive doses of 1757 IS. Convulsive amounts of the drug (0.4 mg/kg iv) do not influence the spontaneous and evoked firing of the Renshaw cells. These results indicate a further similarity between the mode of action of 1757 IS and strychnine. (Contractor's abstract)

1017

Istituto Superiore di Sanità, Rome (Italy).

SPINAL MECHANISMS INVOLVED IN THE CONVULSANT ACTION OF 5-7- DIPHENYL-1-3-DIAZADAMANTANE-6-OL (1757 IS), by V. G. Longo. Final rept. Dec. 1, 1960 [18]p. incl. diagrs. refs. (AFOSR-233) (Bound with its AFOSR-234; AD 251239) (AF 61(052)-188) AD 251239 Unclassified

Also published in Jour. Pharmacol. and Exper. Ther., v. 132: 240-244, 1961.

It was shown previously from this laboratory that 1757 IS has convulsant actions similar to those of strychnine. The present work describes the effects in spinal anesthetized cats of 1757 IS on mono- and polysynaptic reflexes, on spinal primary inhibition, and on the spontaneous and evoked discharge of single interneurones at the level of the spinal cord. Augmentation of the polysynaptic reflexes was noticed after the intravenous administration of 0.1-0.4 mg/kg of the drug. Monosynaptic reflexes were not affected. The inhibition exerted by an afferent volley to the quadriceps nerve on the monosynaptic response due to stimulation of the biceps-semitendinosus nerves was blocked or diminished after the injection of subconvulsive doses of 1757 IS. Convulsive doses of the agent (0.4 mg/kg, intravenously) did not influence the spontaneous and evoked firing of the Renshaw cells. In all these actions, 1757 IS resembled strychnine but not pentylenetetrazol. These results, combined with earlier data obtained in this laboratory, strongly suggest that the principal action of 1757 IS, like that of strychnine, is to abolish spinal inhibition, probably via interference with the postualted inhibitory transmitter.

1018

Istituto Superiore di Sanità, Rome (Italy).

EFFECT OF MEPHENESIN ON THE REPETITIVE DISCHARGE OF SPINAL CORD INTERNEURONS, by V. G. Longo. Final rept. Dec. 1, 1960 [24]p. incl. diagrs. refs. (AFOSR-234) (Bound with its AFOSR-233; AD 251239) (AF 61(052)188) AD 251239 Unclassified

Also published in Arch. Internat'l. Pharmacodyn. et Ther., v. 132: 222-236, 1961.

The effect of mephenesin on the electrical activity of single spinal cord neurons was registered by means of microelectrodes. A diminution of both the spontaneous and the evoked firing was observed after 20 to 40 mg/kg of the drug. This diminution did not occur in all cases. The results obtained are compatible with the hypothesis of a depressive action of mephenesin on the activity of some interneurons.

1019

Istituto Superiore di Sanità, Rome (Italy).

[SPINAL ACTION OF "MEFENESINA" ON THE REPETITIVE FREQUENCY OF SINGLE CELLS OF THE SPINAL CORD] Azione della mefenesina sulla scarica ripetitiva di singole cellule del midollo spinale, by V. G. Longo. [1960] [6]p. incl. illus. (AFOSR-2184) (AF 61(052)188) Unclassified

Presented at Twelfth Cong. Nazionale Soc. Ital. di Fisiologia, Montecatini (Italy), Oct. 6-8, 1960.

Also published in Boll. Soc. Ital. Biol. Sper., v. 36: 1745-1749, 1960.

The mechanism is described with which the mephenesin (orthotoluoxypropanediol) (M.) and other pharmaceuticals with analogous action produce the relations, and for strong doses, the paralysis of the voluntary muscles.

1020

Itek Corp., Boston, Mass.

OPTICAL IMAGE FORMATION IN TERMS OF ENTROPY TRANSFORMATIONS, by E. L. O'Neill and T. Asakura. Final rept. Apr. 1960, 31p. incl. diagrs. refs. (Rept. no. P-163) (AFOSR-TR-60-63) (AF 49(638)577) AD 237436 Unclassified

Also published in Jour. Phys. Soc. Japan, v. 16: 301-317, Feb. 1961.

Three major developments were associated with problems in image formation optics in the last decade: the application of Communication and Information Theory concepts to optics, the theory of partial coherence, and the matrix approach to image formation. It is shown that these three developments are intimately related. Starting with E. Wolf's (Nuovo Cimento, v. 12: 884, 1954) general theory of image formation in terms of the mutual coherence function, it is shown that both the matrix and communication approaches flow naturally

1020 (continued)
from it. These latter two are themselves closely related. Some new results showing the change in entropy loss as a function of focal position are presented both from a geometrical and physical optics point of view. The arguments presented are confined to the special but important case of quasi-monochromatic illumination. For sources of arbitrary spectral width and time varying fields, the generalized theory has not been fully developed. (Contractor's abstract)



James Forrestal Research Center, Princeton, N. J.
see Princeton U. James Forrestal Research Center, N. J.

1021

Johns Hopkins U. Dept. of Aeronautics, Baltimore, Md.

THE TRANSIENT BEHAVIOR OF NONLINEAR SYSTEMS, by F. H. Clauser. Apr. 1960, 56p. incl. diagr. (AFOSR-TN-60-397) (AF 49(638)496) AD 237000; PB 147520 Unclassified

Also published in I. R. E. Trans. on Circuit Theory, v. CT-7: 446-458, Dec. 1960.

The classical perturbation procedure for treating nonlinear systems is shown to lead to solutions expressed as Fourier-like series with slowly varying coefficients. An operational procedure is presented for treating oscillations having slowly variable amplitudes and frequencies. An extension of the usual impedance concepts is presented for expressing the frequency characteristics of both linear and nonlinear elements when oscillations with many frequencies are present simultaneously and when these oscillations vary in both frequency and amplitude. A perturbation procedure is then devised which permits the behavior of systems to be computed with any order of accuracy, using only the algebraic processes which are characteristic of operational procedures. This procedure expresses its results in terms of the fundamental characteristics of the oscillations. The solutions have the desired long term validity and may be used to obtain asymptotic estimates of the behavior of the system. The method is able to treat systems containing nonlinear perturbing elements. (Contractor's abstract)

1022

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

THE EFFECT OF SUBSTITUTION ON THE IONIZATION POTENTIALS OF FREE RADICALS AND MOLECULES. I. A NEW SET OF CONSTANTS, THE δ_K VALUES, by J. J. Kaufman and W. S. Koski. [1960] 25p. incl. tables, refs. (AFOSR-TN-60-52) (AF 18-(600)1526) AD 231045; PB 145686 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 3262-3268, July 5, 1960.

Several new applications of ionization potentials are presented. Ionization potentials of certain molecules are quantitative measures of the effect of substitution on ionization potentials in general. Ionization potentials of amines seem to be a measure of an "absolute" Lewis base strength uncomplicated by steric effects. Using substituted amines as a standard, a new set of constants, the δ_K values, has been calculated. δ_K values quantitatively reflect the change in ionization potential with substitution. Comparison of δ_K values for multiple substitutions definitely confirms postulated "saturation" effects in the aliphatic series. Another series of constants, the $\delta_{K\text{-}Me}$ which represent the change in ionization potential by substituting groups for methyl groups, was calculated and appears to be directly related to Taft σ^* values. The δ_K values when properly used are additive and as a check the ionization potentials of the alkyl radicals were calculated using the δ_K method; agreement with experiment was excellent. (Contractor's abstract)

1023

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

KINETICS OF THE DEUTERIUM EXCHANGE BETWEEN DIBORANE AND DIMETHYLAMINODIBORANE, by J. S. Rigden and W. S. Koski. [1960] [23]p. incl. diagrs. tables, refs. (Technical note no. 14) (AFOSR-TN-60-470) (AF 18(600)1526) AD 237056; PB 147764 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 552-555, Feb. 5, 1961.

The kinetics of the deuterium exchange between diborane and dimethylaminodiborane have been studied. The course of the reaction was followed by means of gas density measurements. The concentrations of both reactants were varied over a 20-fold range in order to establish the orders of the reaction. The reaction was found to be first order with respect to dimethylaminodiborane and half-order with respect to diborane. The activation energy was found to be 27.8 ± 3 kcal. By variation of the surface-to-volume ratio it was determined that, to within experimental error, the reaction is homogeneous. A mechanism has been proposed in which the rate-determining step is the reaction between the intermediate BH_3 and dimethylaminodiborane. The rather high activation energy is consistent with a postulated symmetrical intermediate in the rate-determining step. (Contractor's abstract)

1024

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

IODINE NUCLEAR QUADRUPOLE RESONANCE SPECTRA OF SOME BORON-IODINE COMPOUNDS, by W. G. Laurita and W. S. Koski. [1960] 12p. incl. tables. (Technical note no. 13) (AFOSR-TN-60-471) (AF 18(600)1526) AD 237057; PB 147763 Unclassified

The 1/2 → 3/2 iodine nuclear quadrupole transitions in iododecaborane (4) and iodopentaborane (1) have been observed at 190.8 and 196.2 mc/sec, respectively. The splittings of the iodine resonances in BI_3 were measured for the 1/2 → 3/2 and 3/2 → 5/2 transitions. These splittings were 24 ± 2 and 43 ± 3 mc/sec, respectively. The corresponding splittings in the iodoboranes are believed to be smaller than the resolution of the equipment and consequently have not been detected. The quadrupole coupling constants are interpreted in terms of the electronic structure of the boron-iodine

bonds. The splittings of the resonances in BI_3 were found to be in reasonable agreement with theoretical expectations. (Contractor's abstract)

1025

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

FAR INFRARED SPECTRUM AND STRUCTURE OF DISILOXANE, by J. R. Aronson, R. C. Lord, and D. W. Robinson. [1960] [4]p. incl. diagrs. refs. (AFOSR-2367) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)468 and National Science Foundation) Unclassified

Also published in Jour. Chem. Phys., v. 33: 1004-1007, Oct. 1960.

Inspection of the infrared absorption of gaseous disiloxane in the region of 50-150 cm^{-1} shows that significant absorption is confined to the lower portion of the range. A broad band with 5 rather flat maxima at about 56.4, 69.2, 80.1, 90.5, and 100 cm^{-1} is interpreted at the spectrum of the mixed vibrational and rotational transitions of a quasi-linear triatomic molecule. The consequences of this model of disiloxane for the vibrational spectra of the molecule at higher frequencies are discussed and various unusual features of the spectra are explained on the basis of the model. (Contractor's abstract)

1026

Johns Hopkins U. Dept. of Mathematics, Baltimore, Md.

I. ON BOUNDARY VALUE PROBLEMS FOR SYSTEMS OF ORDINARY, NON-LINEAR SECOND ORDER DIFFERENTIAL EQUATIONS. II. ON THE DIFFERENTIATION OF A MULTIPLE INTEGRAL DEPENDING ON A PARAMETER, by P. Hartman. Jan. 1960 [32]p. incl. refs. (Technical note no. 15) (AFOSR-TN-60-111) (AF 18(603)41) AD 234918 Unclassified

Part I also published in Trans. Amer. Math. Soc., v. 96: 493-509, Sept. 1960.

Part I. Non-singular and singular boundary value problems are investigated for a system of equations of the type $x'' = f(t, x, x')$ in which x and f are vectors. The principal results depend on a priori bounds for the 1st derivatives of bounded solutions $x = x(t)$. These a priori bounds are generalizations of Nagumo's results for the scalar case. Nagumo's condition $|f| \leq \varphi(|x'|)$, where $\varphi(u)$ satisfies $\int^{\infty} udu/\varphi(u) = \infty$, does not suffice for the existence of a priori bounds in the vector case and must be supplemented by other conditions. Part II. There are given sufficient conditions and a simple proof, involving a minimum of topological considerations, for the differentiability of a multiple integral in which both the integrand and domain of integration depend on a parameter. (Contractor's abstract)

1027

Johns Hopkins U. Dept. of Mathematics, Baltimore, Md.

ON SOLUTIONS OF THE HELMHOLTZ EQUATION IN EXTERIOR DOMAINS, by P. Hartman and C. Wilcox. May 1960 [36]p. incl. refs. (Technical note no. 16) (AFOSR-TN-60-582) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)41 and [Office of Ordnance Research] under DA 11-022-ORD-2059) AD 239065; PB 148930 Unclassified

Also published in Math. Zeitschr., v. 76: 228-255, Mar. 1961.

A study is presented for the set of solutions W_H of (Helmholtz equation) $\Delta V + V = 0$ defined on a part of Euclidean space E_p, $p \geq 2$, containing some region $|x| \geq \rho$ (≥ 0) and subject to the Herglotz condition $\limsup r^{-1} \int_{\rho \leq |x| < r} |V(x)|^2 dx < \infty$ as $r \to \infty$. Lim sup in the (Herglotz condition) is shown to be able to be replaced by lim and this limit is shown to serve as a squared norm $\|V\|_H^2$ which makes W_H a pre-Hilbert space. Under this norm, W_H is isomorphic to a dense linear manifold in $L^2(U) \times L^2(U)$, where U is unit sphere $|x| = 1$ in E_p. W_H can be written as a direct sum of its (non-orthogonal) linear manifolds $W_H(E)$ consisting of entire solutions of Helmholtz equation minus the Herglotz condition and of W_S consisting of solutions of (Helmholtz) subject to the Sommerfeld radiation condition. $W_H(E)$ is shown to be Hilbert space and various isomorphisms between $W_H(E)$ (or certain of its subsets) and $L^2(U)$ (or certain of its subsets) are investigated. Characterizations and integral representations for elements of W_S are discussed. Most of the analysis is based on expansions of functions of U in terms of spherical harmonics. (Contractor's abstract)

1028

Johns Hopkins U. Dept. of Mathematics, Baltimore, Md.

ON STABILITY IN THE LARGE FOR SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS, by P. Hartman. June 1960 [19]p. incl. refs. (Technical note no. 17) (AFOSR-TN-60-656) (AF 18(603)41) AD 242528 Unclassified

Also published in Canad. Jour. Math., v. 13: 480-492, 1961.

The stability of systems of real differential equations $x' = f(x)$ or $x' = f(t, x)$, where $t \geq 0$ and x is a point of a complete Riemannian manifold M^n, is discussed. The assumption is made that the Hermitian part $\|e_{jk}\|^H$ of the tensor $e_{jk} = g_{jm} f^m_{,k}$ is negative definite. If $M^n = E^n$ is Euclidean space, this means that the

Hermitian part J^H of the Jacobian matrix $J = (\partial f/\partial x)$ is negative definite. A typical result for the case $M^n = E^n$ in the autonomous case $x' = f(x)$ is as follows: Let $f(x) \in C^1(E^n)$ and $\lambda(|x|)I + J^H(x)$ be negative definite, where $\lambda(r)$ is a non-increasing, positive function satisfying $\int^\infty \lambda(r)dr = \infty$. Then the map T: $y = f(x)$ of E^n to E^n is one-to-one and onto, and every solution of $x' = f(x)$ satisfies $x(t) \to x_0$, $t \to \infty$, where $f(x_0) = 0$. (Contractor's abstract)

1029

Johns Hopkins U. Dept. of Mathematics, Baltimore, Md.

ON EXISTENCE IN THE LARGE OF SOLUTIONS OF HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS, by J. P. Shanahan. July 1960 [15]p. (Technical note no. 18) (AFOSR-TN-60-1060) (AF 18(603)41) AD 251486; PB 154248 Unclassified

Also published in Rend. Circ. Matem. Palermo, Series II, v. 11: 225-236, 1962.

Existence in the large of solutions of $z_{xy} = f(x, y, z, p, q)$, where $z(x, 0)$ and $z(0, y)$ are prescribed, is considered. Theorems proved are analogues of theorems in ordinary differential equations. For example, a condition on f sufficient to ensure existence in the large is $|f(x, y, z, p, q)| \leq \varphi(|z| + |p| + |q|)$, where $\varphi(t)$ is a positive, non-decreasing, continuous function, defined for $t \geq 0$, satisfying $\int^\infty dt/\varphi(t) = \infty$. This is an analogue of a theorem of Wintner in ordinary differential equations. An analogue of another theorem of Wintner on the asymptotic behavior of solutions is also proved. (Contractor's abstract)

1030

Johns Hopkins U. Dept. of Mathematics, Baltimore, Md.

ON DIFFERENTIAL EQUATIONS AND THE FUNCTION $J_u^2 + Y_u^2$, by P. Hartman. Nov. 1960 [42]p. incl. refs. (Technical note no. 19) (AFOSR-TN-60-1374) (AF 18(603)41) AD 251487; PB 154249 Unclassified

Also published in Amer. Jour. Math., v. 83: 154-188, Jan. 1961.

Let q(t) be real-valued for $t > 0$. In the first part of the paper, there is derived simple conditions which imply that (1) $u'' + q(t)u = 0$ has a pair of real-valued solutions $u = x(t), y(t)$ with the property that $z(t) = x(t) + iy(t)$ satisfies $|z| > 0$, $|z|' \leq 0$, $|z|'' \geq 0$ or $|z| > 0$, $|z|' \geq 0$, $|z|'' \leq 0$. This gives a short "differential equation" proof for the known monotony properties of $|z(t)|$, where $z(t) = t^{1/2}(J_\mu + iY_\mu)$ and J_μ, Y_μ are Bessel functions of order $\mu \geq 0$. In the last part of the paper, it is shown that if q has a completely monotone derivative and $0 < q(\infty) \leq \infty$, then (1) has a solution $z(t) = x(t) + iy(t)$ with the property that $|z(t)|^2$ is completely monotone. The proof is rather long and gives results on linear and non-linear differential equations of all orders. (Contractor's abstract)

1031

Johns Hopkins U. Dept. of Mathematics, Baltimore, Md.

ON THE EXISTENCE OF LARGE OR SMALL SOLUTIONS OF LINEAR DIFFERENTIAL EQUATIONS, by P. Hartman. Nov. 1960 [13]p. (Technical note no. 20) (AFOSR-TN-60-1411) (AF 18(603)41) AD 251488; PB 154250 Unclassified

Also published in Duke Math. Jour., v. 28: 421-429, Sept. 1961.

An analysis deals with a scalar differential equation (1) $u'' + q(t)u = 0$, a system of first order equations (2) $x' = A(t)x$, and a system of second order equations (3) $x'' + A(t)x = 0$ on a t-interval $0 \leq t < w$ ($\leq \infty$). It is concerned with the existence of solutions which are either unbounded or tend to 0 as $t \to w$. One result states, for instance, that if A(t) is Hermitian, positive definite, non-decreasing [or non-increasing] and $\det A(t) \to \infty$ [or 0] as $t \to w$, then (3) has a solution $x = x(t) \not\equiv 0$ which tends to 0 [or is unbounded] as $t \to w$. (Contractor's abstract)

1032

Johns Hopkins U. [Dept. of Mathematics] Baltimore, Md.

ON HYPERSURFACES WITH NO NEGATIVE SECTIONAL CURVATURES, by R. Sacksteder. [1959] [22]p. incl. refs. (AF 18(603)41) Unclassified

Published in Amer. Jour. Math., v. 82: 609-630, July 1960.

The following theorem is proved: Let M be a complete n-dimensional Riemannian manifold ($n \geq 2$), $X: M \to E^{n+1}$ an isometric imbedding of class C^{n+1} of M into Euclidean space E^{n+1}. Then, if at each point of M the curvature in every direction is non-negative and not identically zero, X(M) is a convex surface, that is, is the boundary of a convex body. This theorem in the case $n = 2$ was proved by various authors (Hadamard, Stoker, Chern and Lashof). The case $n > 2$ was considered by Van Heijenoort, but in place of the condition concerning curvature of the manifold M there was required the local convexity of X(M). An appendix is also included in which an example is constructed of a twice differentiable surface Φ with an elliptical point P_0, at which are attained the maximum mean and minimum Gaussian curvatures, but where no neighborhood of P_0 is a spherical surface. This example is in connection with the following theorem of Weyl: If at a point P of a four-times continuously differentiable surface with positive curvature the maximum mean and minimum Gaussian curvatures are attained, then in a neighborhood of this point the surface is a sphere.

1033

Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

DIRECTIONAL SENSITIVITY FOR A FINITE HOT-WIRE ANEMOMETER, by S. Corrsin. [1959] [14]p. incl. diagrs. (AFOSR-TN-60-171) (AF 49(638)248) AD 234946 Unclassified

For an infinite heated cylinder oblique to a uniform flow, it follows from the equations of motion that the total heat loss rate depends only on the normal component of undisturbed velocity. This corresponds to the "cosine law" of cooling. When the cylinder is of finite length, with ends maintained at ambient fluid temperature, departures occur which increase with the relative heat loss rate to the ends. (Contractor's abstract)

1034

Johns Hopkins U. Dept. of Mechanics, Baltimore, Md.

SOME CORRECTIONS TO THE LINEARIZED RESPONSE OF A CONSTANT TEMPERATURE HOT-WIRE ANEMOMETER OPERATED IN A LOW SPEED FLOW, by W. G. Rose. [1960] [25]p. (AFOSR-TN-60-1458) (AF 49(638)248) Unclassified

Presented at the Winter annual meeting of the Amer. Soc. of Appl. Mech., New York, N. Y., Nov. 27-30, 1960.

Also published in Jour. Appl. Mech., v. 29: 554-558, Sept. 1962.

A relationship is obtained for the instantaneous response of a constant-temperature hot-wire anemometer having a linearized output. The result includes the second-order effects of variations in fluid temperature and in flow direction. Corrected equations for outputs in terms of mean velocity, turbulent-intensity components, and shear-stress are derived from the instantaneous response. (Contractor's abstract)

1035

Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

STUDY OF INITIAL CONDITIONS IN CONSTANT VELOCITY IMPACT, by J. F. Bell. [1960] [8]p. incl. diagrs. (AFOSR-TN-60-838) [AF 49(638)423] Unclassified

Also published in Jour. Appl. Phys., v. 31: 2188-2195, Dec. 1960.

Diffraction grating measurements are made of dynamic plastic strain within a few thousandths of an inch from the impact face of 1-in. diam, annealed Al specimens in free flight undergoing constant velocity impact. From these data it has been established that initial nondispersive shock fronts are present, even in low-velocity impact. This initial nondispersive front develops in the first 1/4 diam in two sections, each involving 1/2 the initial kinetic energy; the first section is that of the deviatoric, or shear, component, and the second is associated with the hydrostatic stress. It is shown that the dynamic stress-strain curves obtained experimentally in annealed Al and Cu may be computed directly from the theory, using information supplied by the static stress-strain curve. The von Karman critical velocity for annealed Al is found to be a dividing point between two types of initial wave development. (Contractor's abstract)

1036

Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

AN EXPERIMENTAL STUDY OF THE UNLOADING PHENOMENON IN CONSTANT VELOCITY IMPACT, by J. F. Bell. [1960] [15]p. incl. diagrs. tables, refs. (AFOSR-TN-60-839) [AF 49(638)423] Unclassified

Published in Jour. Mech. and Phys. Solids, v. 9: 1-15, Feb. 1961.

The coefficient of restitution, time of contact, and plastic strain distribution are determined experimentally for finite length annealed Al-rods. These data are found to be in agreement with the strain-rate independent theory of plastic wave propagation in which an elastic wave of a magnitude given by the elastic unloading of the static stress-strain curve is reflected from the free end. The case considered is that of 2 identical specimens in free flight collision, dynamic plastic strains being determined by the author's diffraction grating technique. (Contractor's abstract)

1037

Johns Hopkins U. [Dept. of Medicine] Baltimore, Md.

THE ELECTRON AND PROTON, SIGNALS FOR BIOLOGY: A PROSPECTUS FOR MEDICINE BASED ON ENERGY FLOW ACROSS A BALANCED SYSTEM OR TRANSDUCER, THE CELL: PREDICTION OF A CRUCIAL PHOTOCATALYTIC CHAIN, by J. P. Isaacs, J. C. Lamb, and W. R. Brewster, Jr. [1960] [6]p. incl. illus. (AFOSR-TN-60-1438) (AF 49(638)580) AD 456502 Unclassified

Also published in Postgrad. Med., v. 29: 542-547, May 1961.

Two principal themes are cited as bases for a systems analysis of biology: (1) The biologic organism is an energy transducer; (2) it can receive a signal input and transmit a signal output. The cell, being the central biologic unit, is an appropriate focal point for a biologic analysis. Study of a striated muscle-cell model provided considerable insight into the locus and mode of action of many hormones, vitamins, trace metals, and peroxidase-catalase units. It has been possible to interpret essential avenues for energy release and utilization. A direct outgrowth has been visualization of a proton pathway perhaps as important as the electron transport system. Several predictive aspects have arisen concerning the nature and operation of the "relaxing factor" of muscular activity. (Contractor's abstract)

1038

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

TRANSIENT STUDIES OF IONIZATION AND DEIONIZATION PROCESSES IN GASEOUS DISCHARGES, by D. E. Kerr. Final summary rept. July 31, 1960, 1v. incl. diagrs. refs. (AFOSR-TR-60-110) (AF 18(600)-363) Unclassified

The research of this project is discussed in the following sections: (1) The original objectives were to conduct studies of ionization and related mechanisms leading to formation of the stationary state in certain gaseous discharges and to study the ionization and deionization processes in the postdischarge, or afterglow period. The major results are: (a) a large quantity of new quantitative information has been obtained on the behavior of the electron concentration in and light radiated from a He plasma; (b) this information has led to the discovery that many earlier ideas about the afterglow mechanisms were incomplete or inaccurate; and (c) the direction indicates the need for further studies before a reasonable understanding of ionization and deionization processes in low-energy plasmas can be obtained. (2) A discussion is given of the research methods and results to amplify the results given above. (3) A list of reports, talks and publications issued on the work under this contract is given. (4) Advanced degrees resulting from this research are noted. (5) A copy of a reprint (see item no. 1059, Vol. IV) is bound with this report. (6) A distribution list for the report is also included.

1039

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

VOLUME RECOMBINATION AND DIFFUSION IN AFTERGLOWS, by E. P. Gray and D. E. Kerr. [1959] [5]p. incl. diagrs. (Bound with its AFOSR-TR-60-110) (AF 18(600)363) Unclassified

Published in Proc. Fourth Internat'l. Conf. on Ionization Phenomena in Gases, Uppsala (Sweden) (Aug. 17-21, 1959), Amsterdam, North-Holland Publishing Co., v. 1: 84-88, 1960.

To assess the applicability of the microwave method for determining recombination coefficients in the presence of diffusion, an exact numerical solution of the partial differential equation governing the decay of electron concentration in an afterglow is obtained. The results have been applied to discuss measurements for A, Ne, and He. (Contractor's abstract)

1040

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

VOLUME RECOMBINATION AND DIFFUSION IN AFTERGLOWS (Abstract), by E. P. Gray and D. E. Kerr. [1960] [1]p. [AF 18(600)363] Unclassified

Presented at Twelfth annual Gaseous Electronics Conf., Washington, D. C., Oct. 14-16, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 122, Mar. 4, 1960.

The limits of applicability and reliability of the microwave method for determining the recombination coefficient α from the slope of a $1/n$ vs t plot of the decaying electron concentration n in an afterglow are investigated. Numerical solutions have been obtained for spherical and infinite cylindrical plasmas, over a wide range of the parameter $\beta = \alpha n_0 \Lambda^2/D_a$ (n_c = initial central or axial electron concentration, Λ = fundamental diffusion length) of the diffusion equation with a quadratic recombination loss term, for two different initial distributions (lowest "diffusion mode," and uniform). The average electron density weighed by the square of the electric field $\bar{n}$ (the quantity actually measured) was calculated. Solutions of an approximate diffusion equation with recombination, with the Laplacian replaced by $-n/\Lambda^2$, were also evaluated, and the corresponding average electron density compared with the exact one. The following conclusions can be drawn: (1) a linear $1/\bar{n}$ vs t plot does not by itself constitute proof of recombination control unless $\bar{n}$ changes by a factor of at least 5; (2) the slope of the $1/\bar{n}$ vs t plot is close to α only for very large β. Applications of these results to the measurements of recombination coefficients in Ar, Ne, and He will be discussed.

1041

Johns Hopkins U. [Dept. of Physics] Baltimore Md.

RECOMBINATION COEFFICIENT FOR ELECTRONS AND HELIUM (Abstract), by E. P. Gray and D. E. Kerr. [1960] [1]p. [AF 18(600)363] Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 372, June 15, 1960.

Electron density measurements made in the afterglow of a He discharge (at 15-20 mm Hg pressure) have been used to calculate the recombination coefficient α for He molecular ions. A previously described approximation (see item no. 1040, Vol. IV) to a diffusion equation containing both recombination loss and an exponentially decaying electron source arising from molecular metastable-metastable collisions is solved. The approximation consists in replacing $\nabla^2 n$ by $-n/\Lambda^2$ (n = electron density, Λ = fundamental diffusion length). The volume average of n, weighted by the square of the cavity electric field, was compared with the measured electron density. Two of the parameters necessary for this comparison, the decay constant and exponential decay of n at very late times, when all electron loss is presumed due to diffusion of the metastables replenishing the electrons by mutual collision. The only remaining parameter α was then determined by equating measured and calculated values of $\int_0^\infty n\,dt$, yielding $\alpha = 1.3 \times 10^{-9}$ cm^3/sec. The accuracy of this value will be discussed.

1042

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

THE MASS OF THE Λ^0 HYPERON, by E. B. Brucker. Jan. 1960 [81]p. incl. diagrs. tables, refs. (AFOSR-TN-60-72) (AF 18(603)143) AD 236318; PB 146927 Unclassified

The mass of the Λ^0-hyperon was determined in nuclear emulsion from the range and relative orientation of the decay particles of twenty-five Λ^0 decays. The previous emulsion determinations of Friedlander, Q_Λ = 36.9 ± 0.21 mev, and Barkas, Q_Λ = 37.45 ± 0.16 mev, were in disagreement, and the average of their values led to a negative binding energy for the ${}_\Lambda H^3$ hyperfragment. The new determination resulted in a Λ^0 mass of 1115.55 ± 0.15 mev, which corresponded to a Q-value of 37.71 ± 0.14 mev. This new Q-value averaged with that of Barkas yielded a binding energy for ${}_\Lambda H^3$ of +0.12 ± 0.26 mev. The density and thicknesses of the pellicles of the emulsion stack were accurately determined using, respectively, Archimedes' principle and a dial indicator. The ranges and the angles of the secondary tracks were measured by several independent observers. The track lengths in each pellicle were required to agree with each other to within 1%, while the dip angles and the projected angles were required to agree within 1° and 0.50°, respectively. Remeasurements were made until all quantities fulfilled these criteria. For each measured quantity, several techniques were employed and studies were made to insure against the presence of any systematic measurement errors. The ranges were corrected for the difference between the density of this emulsion and the standard emulsion of Barkas, whose range-energy relation was used. The distortion vector was measured near the vertex of every event, but the corrections derived from this result were negligible. (Contractor's abstract)

1043

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

ANGULAR DISTRIBUTION OF K_L-MESON SECONDARIES, by E. B. Brucker, A. Pevsner and others. Jan. 1960 [10]p. incl. diagrs. (AFOSR-TN-60-94) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)143 and Atomic Energy Commission) AD 236319 Unclassified

Presented in part at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-27, 1957.

Presented in part at Seventh annual Rochester Conf., Apr. 15-19, 1957.

The percentage of $K_{\mu 2}$'s in a sample can be enhanced to 75%. The K_L mesons were chosen from 2 samples. One sample accepted K's produced at an angle of 60° to an internal Cu-target at the Bevatron. The other K's were obtained at the Cosmotron from a U-target at a backward angle. The obtained results are described graphically. It is concluded that the angular distribution of K-meson secondaries shows no evidence for a spin of the K-meson greater than zero.

1044

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

THE MASS OF THE Λ^0 HYPERON, by J. Lodge, F. Anderson and others. May 1960 [8]p. incl. diagrs. table. (AFOSR-TN-60-462) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)-143 and National Science Foundation) AD 239421; PB 148956 Unclassified

Also published in Nuovo Cimento, Series X, v. 18: 147-153, Oct. 1, 1960.

The mass of the Λ^0-hyperon was measured using nuclear emulsions: M_Λ = 1115.55 ± 0.15 mev. (Contractor's abstract)

1045

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

AUGER RATE IN μ MESIC ATOMS, by A. Pevsner, R. Strand and others. May 1960 [9]p. incl. diagr. tables, refs. (AFOSR-TN-60-463) (AF 18(603)143) AD 239420; PB 148957 Unclassified

Also published in part in Proc. 1960 Annual Internat'l. Conf. on High Energy Physics, Rochester, N. Y. (Aug. 25-Sept. 1, 1960), New York, Interscience Publishers, Inc., 1960, p. 547-549.

Also published in Nuovo Cimento, Series X, v. 19: 410-414, Feb. 1, 1961.

A study was made of the K Auger transitions in the light elements of nuclear emulsions. Of 3382 stopping μ^--mesons, 1016 were observed to decay. Five of these had associate short-range electrons whose energies were consistent with the K transitions of CNO. Two of these 5 are attributed to the K Auger transitions of CNO, while the remaining 3 are attributed to higher Auger transitions in AgBr. These results are to be compared with the calculations of Burbidge and de Borde, which predict 1.3 K Auger electrons from CNO for this experiment. These experimental results are inconsistent with the assumption that the missing K radiative transitions in the experiment of Stearns and Stearns are due to competing Auger processes, since this would require 294 observed K electrons as compared to the 2 actually observed. The experimental results quoted are in agreement with an earlier experiment of W. F. Fry. (Contractor's abstract)

1046

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

THE MASS OF THE SIGMA-PLUS HYPERON, by

H. F. Perry and A. Pevsner. June 1960 [16]p. incl. diagrs. tables. (AFOSR-TN-60-530) (AF 18-(603)143) AD 239905; PB 149358 Unclassified

The stars produced by mesons (K^-) stopping in nuclear emulsion were investigated to find examples of the decay at rest of $\Sigma^+ \rightarrow p + \pi^0$. Fourteen examples of this decay were obtained. The mean weighted range of the proton, corrected to the range in emulsion of standard density, is 1676.3 ± 7.7 μ. This corresponds to a kinetic energy of 18.85 mev. The mass of the Σ^+ was found to be 1189.41 ± 0.54 mev. (Contractor's abstract)

1047

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

INCREASED FIELD DEPTH IN TRACK PHOTOGRAPHY BY MEANS OF SPHERICAL ABERRATION, by F. Rasetti. May 1960 [4]p. incl. illus. (AFOSR-TN-60-531) (AF 18(603)143) AD 239950; PB 149359 Unclassified

A lens, provided with spherical aberration, was modified by increasing the spacing between the first two and the third elements of the lens. This modification resulted in increased field depth for use in track photography.

1048

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

A DETERMINATION OF BACKGROUND RADIATION AND THE EFFECT OF SHIELDING, by H. F. Perry and A. Pevsner. June 1960 [11]p. incl. diagrs. (AFOSR-TN-60-548) (AF 18(603)143) AD 239949; PB 149360 Unclassified

An investigation of the background radiation, in particular that due to "slow electrons," was undertaken to determine the rate of contamination of undeveloped nuclear emulsions. Unshielded emulsions were found to pick up 4×10^5 tracks/cm^3/day in the 35-200 kev energy range. In a specially constructed iron safe the background was reduced and emulsions picked up only $.09 \times 10^5$ tracks/cm^3/day. Under the shielded conditions, the latent images faded at a faster rate than the background was acquired. (Contractor's abstract)

1049

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

BEAM OPTICS ANALYSIS USING THE IBM 650, by P. E. Schlein. Nov. 1960 [26]p. incl. diagrs. table. (AFOSR-TN-60-1480) (AF 18(603)143) AD 250102 Unclassified

An IBM computer program, BOMMIT (Beam Optics Matrix Multiplication and Iteration), is described for facilitation of precision particle beam optics system design. A beam system consisting of an arbitrary ordering, type, and number of optical elements up to a maximum of 50 can be considered. The matrix method is used.

1050

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

HYPERFRAGMENT PRODUCTION IN THE HELIUM BUBBLE CHAMBER (Abstract), by E. M. Harth, A. Pevsner and others. [1960] [1]p. [AF 18(603)143] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 11, Jan. 27, 1960.

The Duke helium bubble chamber has been exposed to a low momentum separated K^- beam at the Bevatron. In reactions in which the K^- was absorbed at rest, $_\Lambda H^3$, $_\Lambda H^4$, and $_\Lambda He^4$ hypernuclei have been identified from the production channels $K^- + He^4 \rightarrow \pi^- + p + {}_\Lambda H^3$, $\pi^\circ + {}_\Lambda H^4$, $\pi^- + {}_\Lambda He^4$. To date, 20 hypernuclei have been found among about 1500 K^- stops. The following decay modes have been observed; $_\Lambda H^3 \rightarrow p + d + \pi^-$ and $p + p + n + \pi^-$; $_\Lambda H^4 \rightarrow He^4 + \pi^-$ and $H^3 + n$; $_\Lambda He^4 \rightarrow \pi^- + p + He^3$. $d + d$. $He^3 + n$ and $\pi^0 + He^4$. Preliminary estimates of frequency of production, branching ratios, and lifetimes of the hyperfragments will be reported.

1051

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

HYPERFRAGMENT FORMATION IN $K^- + He^4$ CAPTURES AT REST AND K - Λ RELATIVE PARITY, by M. M. Block, E. B. Brucker and others. [1960] [4]p. incl. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)-143], Atomic Energy Commission, National Science Foundation, and Office of Naval Research) Unclassified

Published in Proc. 1960 annual Internat'l. Conf. on High Energy Physics, Rochester, N. Y. (Aug. 25-Sept. 1, 1960). New York, Interscience Publishers, 1960, p. 419-422.

The systematics of hyperfragment formation in $K^- - He^4$ interactions, in particular the absolute and relative rates of formation, are discussed. The production reactions $K^- + He^4 \rightarrow {}_\Lambda He^4 + \pi^-$ and $K^- + He^4 \rightarrow {}_\Lambda H^4 + \pi^0$ were investigated. The various decay modes are discussed and illustrated. Spin assignments and relative K-Λ parity were also studied.

1052

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

THE Σ-Λ CONVERSION PROCESS IN K^--He ABSORPTION, by the Helium Bubble Chamber Collaboration Group. [1960] [4]p. incl. diagrs. (Sponsored jointly by [Air Force Office of Scientific Research under AF 18(603)143], Atomic Energy Commission, National Science Foundation, and Office of Naval Research) Unclassified

Also published in Proc. 1960 annual Internat'l. Conf. on High Energy Physics, Rochester, N. Y. (Aug. 25-Sept. 1, 1960). New York, Interscience Publishers, 1960, p. 423-426.

Single nucleon absorption was found to be the predominant mechanism in K^--He^4 interactions. This process has 3 channels: direct Λ production, direct production, $\Sigma \rightarrow \Lambda$ conversion. An estimate of the relative fractions of these reactions was obtained by studying the pion momentum spectrum. It was found that the fraction of Σ hyperons which convert to Λ hyperons relative to the total number present in the initial single nucleon interaction is approximately 50%. No evidence of parity nonconservation was found in the $\Sigma \rightarrow \Lambda$ conversion process.

1053

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

K^- INTERACTIONS AT REST IN HELIUM, by the Helium Bubble Chamber Collaboration Group. [1960] [5]p. incl. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)-143], Atomic Energy Commission, National Science Foundation, and Office of Naval Research) Unclassified

Also published in Proc. 1960 annual Internat'l. Conf. on High Energy Physics, Rochester, N. Y. (Aug. 25-Sept. 1, 1960) New York, Interscience Publishers, 1960, p. 426-431.

A study was made of K^- interactions at rest in He. The fraction of multinucleon capture was determined and found to be 17 ± 4%. The reactions $K^- + He^4 \rightarrow \Sigma^+ + \pi^- + H^3$, $K^- + He^4 \rightarrow \Sigma^- + \pi^+ + H^3$, and $K^- + He^4 \rightarrow \Lambda^0 + \pi^- + He^3$ were analyzed. The rates of the first 2 equations, compared to the total number of cases in which a $\Sigma^+ \pi^-$ emerged, were found to be 64 ± 10% for the first and 63 ± 10% for the second reaction. It was found that the probability that an H^3 or an He^3 emerge when a Σ or Λ is produced is independent of the energy released. A model for these interactions is discussed.

1054

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

LIFETIME ESTIMATES FOR THE HYPERNUCLEI $_\Lambda H^4$, $_\Lambda He^4$ AND $_\Lambda H^3$, by M. M. Block, E. [B.] Brucker and others. [1960] [2]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)143], Atomic Energy Commission, Natural Science Foundation, and Office of Naval Research) Unclassified

Also published in Proc. 1960 annual Internat'l. Conf. on High Energy Physics, Rochester, N. Y. (Aug. 25-Sept. 1, 1960). New York, Interscience Publishers, 1960, p. 595-596.

Hyperfragment formation was observed in a He bubble chamber exposed to a K^- meson beam. A max likelihood for the lifetime of $_\Lambda He^4$ hypernuclei, based on the ranges of 19 events, gave a most probable lifetime = ∞, but the value of τ one standard deviation away is 1.4×10^{-10} sec. The lifetime values for $_\Lambda H^4$ and $_\Lambda H^3$ are determined to be $(1.53\ ^{+4.0}_{-0.5}) \times 10^{-10}$ sec and 1.8×10^{-10} sec, respectively. These results are compatible with the hyperfragment lifetimes allowed by the model of Dalitz and Liu.

1055

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

SEARCH FOR EVIDENCE OF PARITY NONCONSERVATION IN K-He INTERACTIONS, by M. M. Block, E. B. Brucker and others. [1960] [2]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)143], National Science Foundation, and Office of Naval Research) Unclassified

Published in Phys. Rev., v. 120: 570-571, Oct. 15, 1960.

Parity conservation in strong strange-particle producing interactions is not yet experimentally settled. A search for evidence of parity nonconservation in K-He interactions is described. The evidence is obtained by measuring the expectation value of the pseudoscalar $P_\Lambda \cdot \sigma_\Lambda$. This quantity is directly obtained from the decay-pion angular distribution in the Λ rest frame. The observed angular distribution is symmetric. An analysis of 485 Λ^0 producing interactions gives α $\alpha \langle P_\Lambda \cdot \sigma_\Lambda \rangle = +0.04 \pm 0.08$. Thus, no evidence for parity nonconservation in K-He^4 reactions is found.

1056

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

THE SPECTRA OF RARE EARTH IONS, by G. H. Dieke. Annual technical operating rept. no. 1, Dec. 31, 1959 [27]p. incl. illus. diagrs. table. (AFOSR-TN-60-43) (AF 49(638)535) AD 230729; PB 145687 Unclassified

Attempts were made to produce and analyze a free ion spectra and furnish the unperturbed energy levels which are the necessary foundation for an understanding of

the crystal levels. The procedure followed included: (1) experimental production of the spectra, (2) separation of the ionization stages, (3) wavelength measurements, (4) compilation of a comprehensive table containing all information about the lines, (5) analysis and empirical determination of energy levels, (6) theoretical interpretation and identification, and (7) comparison of the empirical levels with the crystal levels. Steps 1 to 6 were applied to both divalent and trivalent ions; step 7 was applied only to trivalent ions. A wavelength table was completed for Pr to 10,000A and contains 4600 lines classified as to stages of ionization. A partial analysis was successful for Pr IV and Pr III. The 6p → 6s transition were found with fair completeness in both spectra, the 6p → 5d and 5d → 4f groups in Pr IV, and the 6p → 5d and 6d → 6p groups recently in Pr III. Experiments were also conducted on Nd, Er, and Yb. Attempts were also made to find those salts with the sharpest and most isolated levels; the anhydrous trichlorides were generally most satisfactory. The most stable relaxation times of the excited states were of the order of magnitude of 10^{-2} sec.

1057

Johns Hopkins U. Lab. of Astrophysics and Physical Meteorology, Baltimore, Md.

INTERFEROMETRIC DETERMINATION OF FAR INFRARED LINE WIDTHS, by E. V. Loewenstein. Progress rept. Jan. 1, 1960 [122]p. incl. diagrs. tables, refs. (AFOSR-TN-60-65) (AF 18(600)1307) AD 239730; PB 149162 Unclassified

A study was made of pressure broadening of two pure rotational lines: the line of ammonia at 20 cm^{-1} and that of hydrogen chloride at 40 cm^{-1}. The data were analyzed by the Ladenburg-Reiche method to obtain the widths of the lines. The experimental uncertainties present in the data made it necessary to use the calculated line strengths in order to arrive at values of the widths. In addition, the transmission spectra of several discs of sapphire were measured. The channel spectrum arising in the sapphire was analyzed for index of refraction and extinction coefficient. The channel spectrum shows clearly that sapphire is birefringent. The transmission of sapphire in the far infrared was determined. The data were obtained with a special far infrared interferometer which has a max attainable resolution of 0.2 cm^{-1}, covering the range from 8μ to over 4 mm. (Contractor's abstract)

1058

Johns Hopkins U. Lab. of Astrophysics and Physical Meteorology, Baltimore, Md.

DIRECT DETERMINATION OF LINE SHAPES OF ROTATIONAL SPECTRA FROM INTERFEROMETRIC MEASUREMENTS, by T. Williams. Sept. 30, 1959 [21]p. incl. diagrs. (AFOSR-TN-60-349) (AF 18(600)-1307) AD 239732; PB 149161 Unclassified

Presented at meeting of the Opt. Soc. Amer., Ottawa (Canada), Oct. 8-10, 1959.

Abstract published in Jour. Opt. Soc. Amer., v. 49: 1138, Nov. 1959.

The rotational spectrum of a linear molecule may be considered to consist of a number of equally-spaced lines of identical shapes and intensities. Such spectra were scanned with an interferometer rather than a conventional grating spectrometer. It is consequently of interest to know what kind of interferogram may be expected to arise from a periodic spectrum. All the structure in the interferogram is shown to be contained in a sequence of signatures at path differences of 0, 1/2B, 2/2B, ... For a symmetric line shape, the signatures are all symmetric and homologous, but asymmetry in the line shape introduces increasing asymmetry in the successive signatures. These predictions are in agreement with experience. By measuring 2 vertical distances on each signature it is possible to determine as many harmonics in the Fourier expansion of the line shape as there are signatures. Comparison with experimental results from the large interferometric modulator at Johns Hopkins U. is given. (Contractor's abstract)

1059

Johns Hopkins U. Lab. of Astrophysics and Physical Meteorology, Baltimore, Md.

INTERFEROMETRIC SPECTRA OF AMMONIA AND CARBON MONOXIDE IN THE FAR INFRARED, by E. V. Loewenstein. [1960] [3]p. incl. diagrs. (AFOSR-1002) (AF 18(600)1307) AD 262657 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 50: 1163-1165, Dec. 1960.

Spectra of NH_3, NH_2D, and CO were obtained interferometrically and transformed by digital computation. The CO spectrum is used to illustrate the technique, and to show that some information may be obtained directly from the interferograms. The spectrum of NH_3 shows pure rotation and inversion transitions in μ_2 vibrational fundamental. It is concluded that some information is available directly from the interferogram, but to obtain the max use of the data, Fourier transformation must be performed.

1060

Johns Hopkins U. Lab. of Astrophysics and Physical Meteorology, Baltimore, Md.

OPTICAL PROPERTIES OF SAPPHIRE IN THE FAR INFRARED, by E. V. Loewenstein. [1960] [5]p. incl. diagrs. tables. (AFOSR-1003) (AF 18(600)1307) AD 262656 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 51: 108-112, Jan. 1961.

The optical properties of artificial sapphire in the far infrared, utilizing the channel spectrum have been studied. A large interferometer designed for application in the far infrared was used. The interferograms and spectra show that sapphire is birefringent in the far infrared, with $n_{ord} = 3.14 \pm 4\%$ and $n_{ext} = 3.61 \pm 4\%$, in the region 20-60 cm^{-1}. Sapphire is found to be highly transparent from 10-40 cm^{-1}, with the transmission dropping to zero near 90 cm^{-1}.

1061

Johns Hopkins U. Lab. of Astrophysics and Physical Meteorology, Baltimore, Md.

DIRECT DETERMINATION OF LINE SHAPES OF ROTATIONAL SPECTRA FROM INTERFEROMETRIC MEASUREMENTS, by T. Williams. [1960] [4]p. incl. diagrs. (AFOSR-1004) (AF 18(600)1307) AD 262658 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 50: 1159-1162, Dec. 1960.

It is shown that all the structure present in the interferogram of an ideal rotational spectrum consisting of many equally-spaced, identical lines is contained in a sequence of signatures at path differences of 0, 1/(2B), 2/(2B),..., where B is the reciprocal of inertia. For a symmetric line shape the signatures are all symmetric and homologous, the central one being upright and all successive ones inverted; but asymmetry in the line shape introduces increasing asymmetry in the successive signatures. This agrees with experience. Further, by measuring two vertical distances on each signature one may determine as many harmonics of the line shape as there are signatures. As an example, a typical run of the large interferometric modulator is analyzed. (Contractor's abstract)

1062

Johns Hopkins U. Lab. of Astrophysics and Physical Meteorology, Baltimore, Md.

WIDTHS OF FAR INFRARED LINES OF NH_3 AND HCl (Abstract), by E. V. Loewenstein. [1960] [1]p. [AF 18(600)1307] Unclassified

Presented at meeting of the Opt. Soc. Amer., Washington, D. C., Apr. 7-9, 1960.

Published in Jour. Opt. Soc. Amer., v. 50: 511, May 1960.

The line of NH_3 at 20 cm^{-1} and that of HCl at 40 cm^{-1} were investigated with a 12-in. far infrared interferometric spectrometer. The instrument used was the same as described in a previous paper (see item no. 819, Vol. III). The data were analyzed by the Ladenburg-Reiche equivalent width method. Due to the experimental uncertainty in the measurements, it was necessary to have recourse to the calculated values of the line strengths, to arrive at a unique value of the line width.

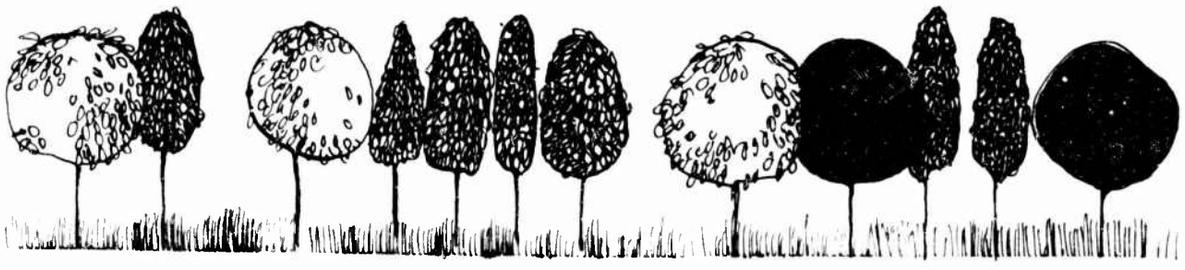
1063

Johns Hopkins U. Lab. of Astrophysics and Physical Meteorology, Baltimore, Md.

VIBRATION-ROTATION BANDS OF AMMONIA. IV. THE STRETCHING FUNDAMENTALS AND ASSOCIATED BANDS NEAR 3 μ, by W. S. Benedict, E. K. Plyler, and E. D. Tidwell. [1959] [13]p. incl. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)1557] and Atomic Energy Commission) Unclassified

Published in Jour. Chem. Phys., v. 32: 32-44, Jan. 1960.

High-resolution spectra of NH_3 are demonstrated. Analysis of the υ_3 fundamental is complete through J' = 9 and presents no unexpected features. Resolution of the K substructure in the υ_1 fundamental shows that several perturbations exist. The most important of these, involving a Fermi resonance with the parallel component of $2\upsilon_2$, and a Coriolis resonance with its perpendicular component, are clarified. Lines in both components of $2\upsilon_4$ are identified through J' = 6, and a strong Coriolis interaction between the l = 0 and l = 2 state is observed and discussed. (Contractor's abstract)



1064

Kansas U. Dept. of Chemistry, Lawrence.

PHOTOMETRIC TITRATION OF AROMATIC AMINES, by C. A. Reynolds, F. H. Walker and E. Cochran. Apr. 22, 1960 [7]p. incl. diagr. table. (AFOSR-TN-60-341) (AF 49(638)472) AD 235641 Unclassified

Also published in Anal. Chem., v. 32: 983-984, July 1960.

Aromatic amines which are unsubstituted or which are substituted with alkyl, alkoxy, hydroxy and halogen groups have been titrated directly with acetic anhydride in pyridine by means of a photometric procedure. The absorbance of the amine in the u.v. region is measured as a function of the volume of standard titrating reagent. Alcohols, phenols, and aliphatic amines cause no interference in the process.

1065

Kansas U. Dept. of Chemistry, Lawrence.

COMPOSITION DEPENDENCE OF THE THERMAL CONDUCTIVITY OF REGULAR SOLUTIONS, by R. J. Bearman and V. S. Vaidhyanathan. [1960] [2]p. incl. table. (AFOSR-1364) (AF-AFOSR-61-7) Unclassified

Also published in Jour. Chem. Phys., v. 34: 264-265, Jan. 1961.

It is demonstrated from the statistical mechanics of transport processes that the product $x\eta$ of the coefficients of thermal conductivity and viscosity may be expected to be independent of the composition in regular solutions. This conclusion is verified for the system benzene-carbon tetrachloride. (Contractor's abstract)

1066

Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden).

NOTE ON THE DISTRIBUTION OF MINERAL SALTS AND "BONE SEEKING" RADIOISOTOPES IN SPONGIOUS BONE TISSUE, by A. Engström and G. Bergendahl. [1958] [4]p. incl. illus. (AFOSR-TN-60-132) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)15 and National Institutes of Health) AD 231685 Unclassified

Also published in Exper. Cell Research, v. 15: 265-268, Aug. 1958.

For abstract see item no. KAR. 02:002, Vol. II.

1067

Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden).

THE PROJECTION X-RAY MICROSCOPE FOR DIVERGENT-BEAM DIFFRACTION, by D. Carlström and B. Lundberg. [1958] [8]p. incl. diagrs. (AFOSR-TN-60-133) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)15 and National Institutes of Health under D-700) AD 231686 Unclassified

Also published in Jour. Ultrastruct. Research, v. 2: 261-268, Dec. 1958.

For abstract see item no. Kar. 02:003, Vol. II.

1068

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

[ON THE CORRELATION OF THE ION EXCHANGE COLUMN WITH MOLECULAR STRUCTURES OF BONE], by A. Engström. Final rept. Nov. 15, 1960, 6p. (AFOSR-238) (AF 61(052)15) AD 251244 Unclassified

This report presents a general survey of work performed under contract AF 61(052)15. Topics include research on bone structure, radiation damage to bones, tracer kinetics, distribution of porophyrin in bone, and bone metabolism.

1069

Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden).

ON THE SOLUTION OF THE COMPARTMENTALIZED TRACER SYSTEM. A SHORT REPLY TO THE PAPER OF BERMAN AND SCHOENFIELD, by P.-E. E. Bergner. [1959] [2]p. (AF 61(052)15) Unclassified

Published in Exper. Cell. Research, v. 20: 579-580, Sept. 1960.

In reply to Berman and Schoenfeld, Bergner states although 5 equations and 5 unknowns are obtained, a unique solution is reached only if all the equations are linear. The non-linearity of these equations implies that it is impossible to distinguish the numbering of compartments 2 and 3 in a tracer system.

1070

Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden).

THE STRUCTURE OF BONE; AN EXCURSION INTO MOLECULAR BIOLOGY, by A. Engström. [1960] [4]p. incl. refs. [AF 61(052)15] Unclassified

Published in Clin Orthopaedics, v. 17: 34-37, Summer 1960.

A summary of present knowledge of the size and molecular structure of the inorganic component in bone and teeth is given. X-ray microscopic measurements have shown the bone crystallites to be needle shaped,

elongated, and ranging in width from 30-60A. X-ray diffraction studies indicate that in mature bone the particles are about 600A long and about 1/10 or less that value in diameter. The effect of the Sr ion on the crystallographic lattice is also discussed.

1071

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

OLFACTORY BULB POTENTIALS INDUCED BY ELECTRICAL STIMULATION OF THE NASAL MUCOSA IN THE FROG, by D. Ottoson. [1959] [13]p. incl. diagrs. refs. (AFOSR-TN-60-1074) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)21 and Swedish Medical Research Council) Unclassified

Also published in Acta. Physiol. Scand., v. 47: 160-172, Nov. 15, 1959.

The potential changes induced in the frog's olfactory nerve and bulb by electrical stimulation of the nasal mucosa have been studied. The response developed by the bulb is composed of two successive negative deflections. The first component of the response is of synaptic nature and builds up a persisting potential during repetitive stimulation. The second component is sensitive to narcotics and asphyxia and is blocked when secondary neurons are stimulated antidromically. This second component represents the propagated activity in secondary neurons. (Contractor's abstract, modified)

1072

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

ON THE MECHANISMS OF DARK ADAPTATION IN DAY- AND NIGHT-INSECTS, by C. G. Bernhard and D. Ottoson. [1959] [2]p. (AFOSR-TN-60-1075) (AF 61(052)21) Unclassified

Also published in Acta. Physiol. Scand., v. 47: 383-384, Dec. 12, 1959.

Diurnal butterflies (Erebia, Argynnis, Vanesso) and nocturnal moths (Cerapteryx, Rhyacio, Geometra, Hepiolus) belonging to Lepidoptera were used to gather information regarding the mechanisms of dark adaptation in day- and night-insects. In the diurnal butterflies, the range of the adaptive change usually did not exceed 1 log unit. The dark adaptation of the nocturnal moths covered a range of change in threshold of 1-1.5 log units, followed by a prolonged second phase covering 1-3 log units, the latency of which varied according to different species tested. The increase of sensitivity in the second phase of dark adaptation in nocturnal insects was connected with the pigment migration which underlies the transition of the compound eye from the opposition into the superposition state.

1073

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

ANALYSIS OF SPINAL INTERNEURONS ACTIVATED BY TACTILE AND NOCICEPTIVE STIMULATION, by G. M. Kolmodin and C. R. Skoglund. [1960] [19]p. incl. diagrs. refs. (AFOSR-715) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)21 and Swedish Medical Research Council) Unclassified

Also published in Acta Physiol. Scand., v. 50: 337-355, 1960.

Seventy-six spinal neurons were classified according to their responses to touch/pressure, movement of hairs, and nociceptive stimulation. For each modality subgroup the excitatory and inhibitory response types, receptive fields, convergence patterns, discharge patterns and histological localization of the cells are described. The dorsal region of the spinal cord showed a predominance of neurons of more simple convergence type, while the medial and ventral regions contained more complex cells with contralateral and suprasegmental connections. Discharge patterns showed characteristic features for various modalities of skin sensation. Typical phenomena of postsynaptic activity, such as spatial summation, afterdischarges and inhibitory rebound, were exemplified and one type of selective inhibition was also described. (Contractor's abstract, modified)

1074

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

RELEASE OF NORADRENALINE FROM ADRENERGIC TRANSMITTER GRANULES BY TYRAMINE, by U. S. von Euler and F. Lishajko. [1960] [2]p. incl. diagr. refs. (AFOSR-TN-60-1385) [AF 61(052)309] AD 246457 Unclassified

Also published in Experientia, v. 16: 376-377, 1960.

Tyramine causes a release of noradrenaline when present in concentrations of 3-100 μg/ml. The effect is most conspicuous in the concentration range 3-20 μg/ml but there is no sharply defined maximum. No certain effect was obtained with dopamine or octopamine in the same concentration range.

1075

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

EFFECT OF RESERPINE AND OTHER DRUGS ON THE RELEASE OF NORADRENALINE FROM ISOLATED TRANSMITTER GRANULES, by U. S. von Euler and F. Lishajko. [1960] [2]p. (AFOSR-288) (AF 61(052)-309) AD 251204 Unclassified

Presented at Tenth Scand. Cong. Physiol., Oslo (Norway) Aug. 22-24, 1960.

Also published in Acta Physiol. Scand., v. 50: Suppl. 175: 45-47, 1960.

Noradrenaline may be released from granules by the action of various drugs in different concentrations. Addition of reserpine in concentrations of 0.05 - 0.36 mg/ml causes release of about 80% noradrenaline while 1 mg/ml of promethazine effects complete release. Both cocaine and lidocaine release noradrenaline in concentrations of 60 mH.

1076

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

STORAGE AND RELEASE OF CATECHOLAMINES, AND THE OCCURRENCE OF A SPECIFIC SUBMICROSCOPIC GRANULATION IN HEARTS OF CYCLOSTOMES, by E. Östlund, G. Bloom and others. [1960] [2]p. incl. illus. table. (AFOSR-289) [AF 61(052)309] AD 251205 Unclassified

Also published in Nature, v. 188: 324-325, Oct. 22, 1960.

Specimens from the heart of the lamprey and the hagfish have been studied with regard to their catecholamine content. The lamprey heart contains chiefly adrenaline present in large amounts in the auricle and ventricles. In the hagfish, the portal heart and the auricle contain mainly adrenaline while adrenaline is dominant in the ventricle. Column chromatography showed that in both cyclostomes adrenaline and noradrenaline were the predominant catechol compounds and that dopamine and dihydroxyphenylacetic acid were present only in small amounts. Electron micrographs of heart specimens from both species revealed the occurrence of cells containing large numbers of dense, osmiophilic granules, round in shape and about 0.1μ in diam. The granules exhibit a border surrounded by a lighter space encircled by a limiting membraneous structure. In view of the large amounts of catecholamines present in the heart tissue of both species it seems possible that these cells are part of the chromaffin system.

1077

Karolinska Inst. [Nobel Inst. for Neurophysiology] Stockholm (Sweden).

[THE LINGUOMANDIBULAR REFLEX AS AN INDEX OF THE CARBON DIOXIDE SENSITIVITY OF THE BRAIN STEM] Der linguomandibuläre Reflex als Index der Kohlensäureempfindlichkeit des Hirnstammes, by I. Jurna and U. Söderberg. [1960] [2]p. incl. diagr. (AFOSR-TN-60-1325) (AF 61(052)119) AD 246185 Unclassified

Also published in Naturwissenschaften, v. 13: 305-306, 1960.

In cats, the linguomandibular reflex, i.e. opening of the mouth in response to electrical stimulation of the tongue, is remarkably sensitive to changes in pCO_2 within physiological limits. Increase causes inhibition, decrease facilitation of the reflex. The CO_2 sensitivity is not depressed by anesthetics as is the case of the respiratory centers and the reticular activating system of the brain. Drugs with well established action on the reticular formation did not influence the reflex. However, strychnine strongly reduced the inhibition by CO_2. Similarly, in a condition of decerebrate rigidity CO_2 failed to influence the reflex. In both cases barbiturates evoked CO_2 sensitivity without changing the size of the reflex contraction. (Contractor's abstract)

1078

Karolinska Inst. Nobel Inst. for Neurophysiology, Stockholm (Sweden).

TEMPORAL CHARACTERISTICS OF THYROID ACTIVITY, by U. Söderberg. [1959] [34]p. incl. diagrs. refs. (AFOSR-TN-60-1493) (AF 61(052)119) AD 248490 Unclassified

Also published in Physiol. Rev., v. 39: 777-810, Oct. 1959.

Temporal characteristics of thyroid activities were described and discussed. The thyroid blood flow shows a rapid response to nervous and hormonal stimuli. Reflexes in the homeostasis of blood pressure and blood volume exert a strong influence. Thyroid stimulating hormone (TSH) accelerates hormone secretion, with a latent period varying from a few minutes to a few days. The latent period is related to species, basal level of thyroid activity and dosage tested. Rate of uptake of iodine increases with a much longer latent period, but the latency is largely proportional to the latency of onset of hormone release. Thyroid nerves and a few hormones other than TSH have no effect on hormone secretion at zero level of activity, but in the presence of TSH-induced secretion their activity markedly modifies the TSH response. Rate of secretion can thereby be increased by 100% within 5 sec. The anterior pituitary acts to maintain thyroid activity at a predetermined level, and a small deviation from that level leads to changes in the output of TSH. The thyroid hormones also accelerate their own breakdown in the periphery, and and, similarly, they influence the turnover rate of TSH. Active thyroid glands respond more rapidly to various stimuli than resting glands. Similarly, peripheral tissues are more readily affected by thyroid hormones in a state of hyperthyroidism than in myxedema. (Contractor's abstract)

1079

Karolinska Inst. Nobel Inst. for Neurophysiology, Stockholm (Sweden).

THE TRANSFER OF OPTIC INFORMATION THROUGH

THE LATERAL GENICULATE BODY OF THE RABBIT, by G. B. Arden and U. Söderberg. [1959] [24]p. incl. diagrs. refs. (AFOSR-1292) (AF 61(052)119) Unclassified

Published in Sensory Communication; Contributions to the Symposium on Principles of Sensory Communication, Endicott House, M. I. T. (July 19-Aug. 1, 1959) [Cambridge] M. I. T. Press, 1961, p. 521-544, (AFOSR-796)

The experiments were performed on rabbits with very little binocular vision. Operative procedures were performed on encéphale isolé (cerebrum isolation), decorticate encéphale isolé, classical and midpontine cerveau isolé (brain isolation). The geniculate responses obtained from the samples are summarized with respect to the nature of the resting activity, long-term fluctuations in resting activity, auditory stimulation, the response to light, arousals, and the effects of reversible retinal ischemia. It is concluded that the geniculate seemed to act as an interpreter of retinal information, as a recoder, and as a mixer. However, the responses of the geniculate cells were so diversified that the material collected was not large enough for a statistical evaluation.

1080

Karolinska Inst. Nobel Inst. for Neurophysiology, Stockholm (Sweden).

LOCAL CONSTRICTION AND SPASM OF LARGE ARTERIES ELICITED BY HYPOTHALAMIC STIMULATION, by N. Weckman. [1959] [3]p. incl. illus. diagrs. (AF 61(052)119) Unclassified

Published in Experientia, v. 16: 34-36, 1960.

A central nervous control of vasomotor activity in large arteries, resembling the vasoconstrictor innervation of small vessels with respect to activation, neural structures, and neuroeffector characteristics, has been found. It usually operates concurrently with the vasoconstrictor control of smaller vessels producing a homologous response in consecutive parts of a vascular loop. Under prolonged activation, the large arteries maintain constriction better than small ones and show evidence of arterial spasm, especially when the system is stimulated at the diencephalic level. It then seems capable of producing independent, isolated constrictions, as judged by the overall vasomotor patterns.

1081

[Keele U.] Staffordshire (Gt. Brit).

HEATS OF FORMATION OF ORGANO-METALLIC COMPOUNDS, LITHIUM n-BUTYL, by C. T. Mortimer. Annual summary rept. no. 1. Dec. 31, 1960 [13]p. incl. diagrs. tables, refs. (Technical scientific note no. 1) (AFOSR-328) (AF 61(052)307) AD 271784 Unclassified

Lithium n-butyl was reacted with H_2O(g) and with benzyl bromide and the heats of reaction were found to be $\Delta H = -57.4 \pm 1.2$ kcal/mol and $\Delta H = -30.8 \pm 1.6$ kcal/mol, respectively. From these measurements, the heats of formation are calculated: $\Delta Hf°(LiC_4H_9) = -31.2 \pm 1.2$ kcal/mol and $\Delta Hf°(C_6H_5CH_2Br) = +8.2 \pm 3.2$ kcal/mol.

1082

Kent State U. [Dept. of Physics] Ohio.

INVESTIGATION OF THE ANOMALOUS PROTON MAGNETIC RESONANCE BEHAVIOR IN LITHIUM SULFATE MONOHYDRATE (Abstract), by K. F. Wylie and A. A. Silvidi. [1960] [1]p. (AFOSR-TN-60-305) (AF 49(638)-168) Unclassified

Presented at meeting of the Amer. Phys. Soc., Antioch Coll., Yellow Springs, Ohio, Apr. 22-23, 1960.

Also published in Bull. Amer. Phys. Soc., Series II, v. 5: 466, Nov. 25, 1960.

A partial proton magnetic resonance investigation of lithium sulfate monohydrate was made by Pake, Soutif and Ayant, and by Hirahara and Murakami. The separation between the resonance lines due to dipole-dipole interaction had been predicted and observed for many crystals. McGrath, et al, in making a further detailed study of lithium sulfate discovered an anomalous behavior. The Pake curves, obtained when the crystal was rotated about its crystallographic a, b and c axes, showed a variable shift in the dipole splitting. An adequate theoretical explanation for these shifts is lacking. This paper describes the attempt made at an experimental explanation of the shifts. The experiments consisted of examining the proton resonances around the minimum points of the Pake curves at various values of the externally applied magnetic field. It was hoped that the shifts could be related to the external fields. The results showed that the shifts are independent of the external fields.

1083

Kent State U. Dept. of Physics, Ohio.

PROTON-MAGNETIC-RESONANCE STUDY OF BARIUM BROMIDE MONOHYDRATE, by J. W. McGrath and A. A. Silvidi. [1960] [4]p. incl. diagrs. refs. (AFOSR-TN-60-376) [AF 49(638)168] AD 252840 Unclassified

Also published in Jour. Chem. Phys., v. 33: 644-647, Sept. 1960.

The proton-magnetic-resonance doublets were obtained for rotation of the crystal around its c axis. From these data, the proton-proton separation was computed to be 1.56 ± 0.02A. The hydrated water molecule was found to lie in one orientation whose proton-proton axis makes direction angles of $\alpha = 89 \pm 1°$, $\beta = 1 \pm 1°$, $\gamma = 90 \pm 6°$, measured from the positive a, b, and c crystallographic axes, respectively. This orientation fits well into the crystal structure and indicates that

the complex, Br_I--H-O-H--Br_{II}, exists. Line widths range from 6.5 to 4.2 gauss and show a correlation with T as a function of orientation. Observation was necessarily made with some saturation. A new effect, an asymmetry of line areas in the doublets, was observed for narrow ranges near 2 crystal orientations. The 2 orientations were symmetrically close to that for which the proton-proton line was parallel to the external magnetic field. It may be due to crossing of the barium quadrupole resonance frequencies over the magnetic-resonance frequencies of the protons. (Contractor's abstract)

1084

Kent State U. Dept. of Physics, Ohio.

PROTON MAGNETIC RESONANCE STUDY OF BARIUM BROMATE MONOHYDRATE, by A. A. Silvidi and J. W. McGrath. Nov. 1960 [2]p. incl. diagr. table, refs. (AFOSR-TN-60-671) (AF 49(638)168) AD 252841 Unclassified

Also published in Jour. Chem. Phys., v. 33: 1789-1790, Dec. 1960.

The proton magnetic resonance absorption spectrum of barium bromate monohydrate was obtained using a Pound-Watkins spectrometer. Results indicate that there is only one orientation of the water molecule in the crystal. The p-p distance is 1.61 ± 0.01A and direction angles of the p-p vector are $\alpha_0 = 30°$, $\beta_0 = 95°$, and $\gamma_0 = 122°$. The experimental errors in these angles were ± 3. Apparently the water molecule is oriented so as to form the complex, $O_{II\ Br}$--H-O-H--$O_{II\ Br}$ where O_{Br} are neighboring bromate oxygens. Results obtained for barium chlorate monohydrate were consistent with those for barium bromate monohydrate. (Contractor's abstract)

1085

Kent State U. Dept. of Physics, Ohio.

STRUCTURE OF THE WATER MOLECULE IN SOLID HYDRATED COMPOUNDS, by J. W. McGrath and A. A. Silvidi. Dec. 1960 [4]p. incl. table, refs. (AFOSR-TN-60-868) (AF 49(638)168) AD 252842 Unclassified

Also published in Jour. Chem. Phys., v. 34: 322-325, Jan. 1961.

The proton-proton separations in hydrated water in 10 compounds have been measured by the Pake method using proton magnetic resonance. The mean value is 1.595 ± 0.003A with a range in values from 1.56 to 1.61A. However, consideration of experimental error in individual values of the p-p separation indicates that this range does not prove that this separation varies between compounds. Thus it appears that intermolecular forces on the protons in the water molecule are not appreciable compared to intramolecular forces The orientations of the water molecules have been determined for eleven compounds. In every instance the orientation appears to be determined by formation of hydrogen bonds between the water oxygen and the nearest pair of electronegative atoms. (Contractor's abstract)

1086

Kent State U. Dept. of Physics, Ohio.

THE MEASUREMENT OF THE PROTON-PROTON SEPARATIONS IN APPROPRIATE HYDRATES BY THE NUCLEAR MAGNETIC RESONANCE TECHNIQUE, by J. W. McGrath and A. A. Silvidi. Final rept. Feb. 1, 1957-Aug. 31, 1960. [29]p. incl. tables, refs. (AFOSR-TR-60-103) (AF 49(638)168) AD 241697; PB 150224 Unclassified

The proton-proton separations in hydrated water in 10 compounds have been measured by the Pake method using proton magnetic resonance. Values range from 1.56A to 1.61A. It appears that intermolecular forces on the protons are not appreciable compared to intramolecular forces . The orientations of the water molecule have been determined for 11 compounds. In every instance the orientation appears to be determined by formation of hydrogen bonds between the water oxygen and the nearest pair of electronegative atoms. (Contractor's abstract)

1087

Kentucky U. Dept. of Chemistry, Lexington.

N-SULFINYL AMINES. TRANS-SULFINYLATION WITH PRIMARY AMINES, by W. T. Smith, Jr., W. K. Plucknett, and T. L. Dawson. Nov. 1960 [23]p. incl. diagrs. table, refs. (AFOSR-TN-60-854) (AF 49(638)-49) AD 246989; PB 153451 Unclassified

The rates of reaction of N-sulfinylaniline with 7 primary aliphatic amines were determined using a spectrophotometric method based on the absorbance of N-sulfinylaniline at 320 mμ. The trans-sulfinylation reaction takes place in 2 distinct stages. The data indicate that the first stage is a first order approach to equilibrium and that the second stage is first order with respect to N-sulfinylaniline. The rate of the reaction is increased by increased solvent polarity. Pyridine has a catalytic effect on the second stage of the reaction. Reaction of the following primary amines were studied: methoxyamine, ethyl glycinate, benzylamine, allylamine, t-butylamine, cyclohexylamine, and n-heptylamine. The rate constants for the forward reaction of the first order approach to equilibrium are generally larger for the more basic amines. The rate constants for the second stage of the reaction can also be correlated with the basicity of the amine. (Contractor's abstract)

1088

Kentucky U. Dept. of Chemistry, Lexington.

N-SULFINYL AMINES. EFFECT OF STRUCTURE

ON THE ALCOHOLYSIS REACTION, by W. T. Smith, Jr. and L. D. Grinninger. July 1960 [2]p. (AFOSR-TN-60-855) (AF 49(638)49) AD 245229; PB 152746 Unclassified

Also published in Jour. Org. Chem., v. 26: 2133-2134, June 1961.

The ultraviolet spectra of both aromatic and aliphatic N-sulfinyl amines have been determined in anhydrous methyl alcohol to determine the reactivity of these compounds with this solvent. The spectra of aromatic N-sulfinyl amines indicated rapid and complete reaction. The N-sulfinylanilines studied were: 2- and 3-nitro-;4-bromo-; 4-iodo-; 4-methyl-; 2,4-dimethyl-; 2,6-dimethyl-; and 4-sec-amyl-. This study shows that even highly hindered N-sulfinylanilines containing electron donating groups (e.g. 2,6-dimethyl-N-sulfinylaniline) can undergo rapid reaction. The rapid rate of reaction of all of the above compounds precluded a study of the effect of substitutents on the rate of reaction. The aliphatic N-sulfinyl amines showed little or no reaction with methylalcohol. The aliphatic N-sulfinylamines studied were: n-heptyl-; tert-butyl-; cyclohexyl-; 2-chloroethyl-; and 3-chloropropyl-. It is proposed that an increase in the base strength of the N-sulfinyl amino group of the aliphatic N-sulfinyl amines causes a decrease in the reaction rate. N-Sulfinyl-tert-butylamine showed no reaction with methyl alcohol. This can be attributed to both the increased basicity of the amine and to steric hindrance of the bulky tert-butyl group.

1089

Kentucky U. [Dept. of Physics] Lexington.

SOME SEMICONDUCTING PROPERTIES OF BISMUTH TRISULFIDE AND BISMUTH TRIOXIDE, by D. M. Mattox. July 31, 1960 [45]p. incl. illus. diagrs. tables, refs. (AFOSR-TN-60-1028) (AF 49(638)90) AD 243169 Unclassified

Samples of Bi_2S_3 were prepared by placing dust-free Bi and S in stoichiometric proportions into a Vycor tube and heating the tube at about 271° C to effect melting. Films of Bi_2O_3 were made by melting Bi metal in a graphite crystal open to the air. The following values were obtained for measurements on Bi_2S_3 and Bi_2O_3, respectively: thermal energy gap of 0.72 ± 0.05 and 2.07 ± 0.07 ev; electrical resistivity of 0.85 ± 0.05 (single crystal) and about 10^4 ohm-cm; optical transmission of 1.2 and 1.4 ev at 300° and 77° K with a temperature dependence of 8×10^{-4} ev/° K, and 2.85 and 3.1 ev at 300° and 77° K with a temperature dependence of 1.1×10^{-3} ev/° K. Other values for Bi_2S_3 were: thermal conductivity of 0.0203 ± 0.0015 w/cm deg (single crystal); Seebeck coefficient of 550 ± 50 μv/° C (single crystal) and 700 to 850 μ v/° C (polycrystal); carrier concentration of 1.2×10^{17} cm^{-3}, and carrier mobility of 65 sq cm/v sec.

1090

Kentucky U. [Dept. of Physics] Lexington.

ELECTRICAL, OPTICAL, AND THERMAL PROPERTIES OF THE $M_2^{Vb} N_3^{VIb}$ SEMICONDUCTORS, by L. Gildart. Final rept. July 1, 1958-Jan. 31, 1961 [129]p. incl. illus. diagrs. tables, refs. (AFOSR-TR-60-124) (AF 49(638)90) AD 268436 Unclassified

The optical, electrical, and thermal properties of group Vb and group VIb elements have been investigated in order to account for such characteristics as resistivity discontinuity and low voltage breakdown. The band gap of 1.35 ev suggests that the absorption seen from 1.2 to 1.3 ev may be due to exciton formation. Consideration of the photoconductive decay and possible recombination processes seems to indicate that the flat spectral response is due to a hole diffusion process even though the hole mobility is small. Resistivity discontinuity observed in $Sb_2 Se_3$ containing excess Sb may be accounted for by the concept of overlapping acceptor orbitals although the quoted excess at which the discontinuity occurs is probably too large.

1091

Kentucky U. [Dept. of Physics] Lexington.

A STUDY OF THE TRANSIENT BEHAVIOR AND THE SWITCHING EFFECT IN ANTIMONY TRISULFIDE, by J. R. Davis. Dec. 17, 1960 [37]p. incl. diagrs. table, refs. (AFOSR-121) (AF 49(638)90) AD 254239; PB 155127 Unclassified

Time and electric field dependent characteristics associated with the switching effect in stibnite were measured. Temperature dependent properties, pre-breakdown pulses and delayed breakdown behavior are also described. Following breakdown the samples exhibit a positive temperature coefficient of resistivity of about 0.004 per centigrade degree at room temperature. At temperatures about 500° K, it is increasingly harder to get unambiguous breakdown behavior due to annealing in the sample. At these higher temperatures, the noise amplitude becomes negligibly small and no breakdown effect is observed.

1092

Kentucky U. [Dept. of Physics] Lexington.

PREBREAKDOWN PULSES IN STIBNITE (Abstract), by J. R. Davis. [1960] [1]p. (Bound with its AFOSR-TR-60-124; AD 268436) (AF 49(638)90) Unclassified

Presented at spring meeting of the Kentucky Section, Amer. Assoc. of Phys. Teachers, Kentucky U., Lexington, May 14, 1960.

Published in Amer. Jour. Phys., v. 28: 762, Nov. 1960.

Prebreakdown pulses and breakdown transitions in stibnite were examined oscillographically following the application of a fast rise time pulse having an amplitude variable to 1500 v. A time delay, of the order of μsec and inversely dependent on the field strength in the sample, was observed between the applied pulse and the inception of either breakdown or prebreakdown behavior.

1093

Küssner, H. G., Goettingen (Germany).

RESEARCH ON THE OSCILLATING ELLIPTIC LIFTING SURFACE IN SUBSONIC FLOW, by H. G. Küssner. Final rept. June 1960 [71]p. incl. diagrs. tables, refs. (AFOSR-TR-60-71) (AF 61(052)215) AD 241997; PB 150333 Unclassified

Starting from the linearized Euler equations, an integral representation of the pressure of the oscillating elliptic lifting surface in subsonic flow is given for arbitrary downwash distributions and arbitrary yaw angles. The kernel of this integral representation is constructed by means of the Green function of the elliptic plate oscillating in still air. Two methods of determination of the Green function are given. The first one uses infinite series of products of ellipsoidal surface harmonics and Lame functions. The second method of determination of the Green function only holds for incompressible flow but gives results in a closed form. This form was used in order to solve the integral equation for the weight function of the leading edge singularity of the lifting surface. The results of this method were used to check the accuracy of the current collocation method of the three-dimensional lifting surface theory. (Contractor's abstract, modified)



1094

Laval U. Dept. of Chemistry, Quebec (Canada).

AN INFRARED STUDY OF HYDROGEN BONDING IN SOLID H_2O_2 AND H_2O-H_2O_2 MIXTURES, by P. A. Giguère and K. B. Harvey. [1959] [10]p. incl. diagrs. tables, refs. [AF 18(600)492] Unclassified

Published in Jour. Molec. Spectros., v. 3: 36-45, Feb. 1959.

The infrared absorption, between 2.5 and 25 μ, of thin films of pure H_2O_2 has been measured at 4° and 80°K. Two types of spectra were observed, 1 crystalline and the other amorphous. The results are discussed in terms of hydrogen bonding and disorder with reference to the case of ice. It is shown that the molecular spectrum of ordinary ice is not crystalline but vitreous. The spectra of frozen mixtures of H_2O_2 and H_2O deposited simultaneously from the vapor indicate large shifts of the intermolecular vibrations in the crystalline dihydrate, $H_2O_2 \cdot 2H_2O$. The principal intermolecular force constant in crystalline H_2O_2 is calculated to be 0.24×10^5 dynes/cm. (Contractor's abstract)

1095

Lehigh U. [Dept. of Mathematics] Bethlehem, Pa.

A UNIQUENESS THEOREM ON CLOSED CONVEX HYPERSURFACES IN EUCLIDEAN SPACE, by S. S. Chern, J. Hano, and C.-C. Hsiung. [1960] [4]p. (AFOSR-3273) (In cooperation with Chicago U., Ill.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)1009 and National Science Foundation) Unclassified

Also published in Jour. Math. and Mech., v. 9: 85-88, Jan. 1960.

The following theorem is proven: Let Σ, Σ' be two closed, strictly convex, C^2-differentiable hypersurfaces in a Euclidean space of dimension $n+1$ (≥ 3). Let $f: \Sigma \to \Sigma'$ be a diffeomorphism such that Σ and Σ' have parallel outward normals at $p \in \Sigma$ and $p' = f(p)$ respectively. Denote by $P_l(p)$ (respectively $P_l(p')$) the l^{th} elementary symmetric function of the principal radii of curvature of Σ (resp. Σ') at p (resp. p'). If, for a fixed l, $2 \leq l \leq n$, $P_{l-1}(p) \leq P_{l-1}(p')$, $P_l(p) \geq P_l(p')$ is obtained for all points $p \in \Sigma$, then f is a translation. The theorem can obviously be extended to a pair of convex hypersurfaces with boundaries.

1096

Leyden U. Lorentz Inst. (Netherlands).

SOME DEDUCTIONS FROM A FORMAL STATISTICAL MECHANICAL THEORY OF CHEMICAL KINETICS, by J. Ross and P. Mazur. [1960] [10]p. incl. refs. (AFOSR-1846) [AF 61(052)16] AD 611514 Unclassified

Also published in Jour. Chem. Phys., v. 35: 19-28, July 1961.

A perturbation solution of an assumed Boltzmann-type equation for bimolecular chemical reactions in a homogeneous gas phase consisting of molecules with or without internal degrees of freedom, leads to the conclusion that the law of mass action as well as the usually assumed phenomenological rate expressions for chemical reactions, is strictly valid only in lowest order of the perturbation. Higher order perturbations introduce an affinity and time dependence in the rate coefficient and the law of mass action becomes inadequate to the extent of the contribution of the effects of the perturbations. (Contractor's abstract)

1097

Liège U. (Belgium).

A TAUBERIAN THEOREM, by F. J. Bureau. Mar. 1960, 35p. (Technical scientific note no. 3) (AFOSR-TN-60-392) (AF 61(052)86) AD 241465; PB 150040 Unclassified

Also published in Math. Ann., v. 142: 270-291, 1960.

The following Tauberian theorem is investigated: If n and p are positive integers such that $0 < p < 2n$ and if $f(t) \geq 0$, $t \in (0, \infty)$ is Lebesgue integrable over any finite interval and such that $T^{-p} \int_0^T f(t)\,dt < M$ for all $T > 0$, M independent of T; then $\lim_{\epsilon \to 0} \epsilon^{p-2n} \int_0^\infty f(t) \frac{\sin^{2n} \epsilon t}{t^{2n}}\,dt = A\,p \int_0^\infty \frac{\sin^{2n} t}{t^{2n+1-p}}\,dt$ (A a constant), implies $\lim_{T \to \infty} T^{-p} \int_0^T f(t)\,dt = A$. The Mellin transform of $u^{-p} \sin^{2n} u$ is given and the general Tauberian theorem of N. Wiener is applied. (Contractor's abstract)

1098

Liège U. (Belgium).

RESEARCH IN HYPERBOLIC DIFFERENTIAL EQUATIONS, by F. J. Bureau. Annual summary report no. 2, Mar. 15, 1960 [3]p. (AFOSR-TN-60-677) (AF 61-(052)86) AD 240353 Unclassified

A summary of research performed under this contract during the period March 15, 1959 to March 14, 1960 is presented. The Cauchy problem for partial differential equations of the order $r > 2$ and $p > 2$ independent variables is investigated with particular attention given to linear operators connnected with integrals otherwise divergent. In addition the boundary problems for totally hyperbolic equations in several independent

variables are considered. The results have appeared in two technical reports (item nos. 854 and 855, Vol. III). The methods and results have been summarized in a short note (item no. 856, Vol. III).

1099

Liège U. (Belgium).

PROBLEMS AND METHODS IN PARTIAL DIFFERENTIAL EQUATIONS. II. THE METHOD OF SINGULARITIES, by F. J. Bureau. July 1960, 86p. incl. refs. (Technical scientific note no. 4) (AFOSR-TN-60-890) (AF 61(052)86) AD 246981; PB 153307 Unclassified

Also published in Ann. Mat. Pura. Appl., v. 55: 323-388, 1961.

The method of singularities is used to solve the Cauchy problem for simple hyperbolic partial differential equations, i.e., the wave equation and the damped wave equation. The representation formula is written in terms of finite parts and logarithmic parts of certain divergent integrals. The explicit representation formulas for the solutions are obtained by performing the analytic continuation by making use of finite and logarithmic parts. (Contractor's abstract, modified)

1100

Litton Industries. Space Research Labs., Beverly Hills, Calif.

PARTICLE MOTION IN AN AXIALLY SYMMETRIC MAGNETIC FIELD, by A. S. Penfold. May 24, 1960, 54p. incl. diagrs. table, refs. (Research study no. 29.15) (AFOSR-TN-60-841) (Also bound with its AFOSR-64-1340; AD 609482, as Appendix C) (AF 49-(638)759) AD 246639 Unclassified

The motion of a charged particle in an electromagnetic field is, under certain circumstances, completely described by a scalar potential which depend on position and time, and also on the "launch" conditions of the particle. This potential gives rise to a type of electric field which couples directly to the charge of the particle. The potential applies equally well to static or to time-dependent fields and the latter may be either stationary or moving. (Contractor's abstract)

1101

Litton Industries. Space Research Labs., Beverly Hills, Calif.

DETERMINING AXIALLY SYMMETRIC MAGNETIC FIELD PATTERNS, by A. S. Penfold. May 24, 1960, 10p. incl. illus. diagrs. (Research study no. 29.14) (AFOSR-TN-60-842) (Also bound with its AFOSR-64-1340; AD 609482, as Appendix F) (AF 49(638)759) AD 246637 Unclassified

A simple method for the determination of some of the properties of a magnetic field is described. The method is applicable provided the field has a certain symmetry about one axis. The required symmetry is not seriously restricting and many field configurations of practical importance are amenable to this technique.

1102

Litton Industries. Space Research Lab., Beverly Hills, Calif.

A MODEL FOR THE MOTION OF A RAREFIED PLASMA IN AN AXIALLY SYMMETRIC FIELD, by A. S. Penfold. July 15, 1960 [25]p. incl. diagr. (Research study no. 29.16) (AFOSR-TN-60-961) (Also bound with its AFOSR-64-1340; AD 609482, as Appendix D) (AF 49(638)759) AD 246638 Unclassified

Equations of motion are derived for the charged constituents of a tenuous plasma immersed in a time independent, axially symmetric, magnetic field. An ion-pair model is employed which assumes strong Coulomb forces. The motion of the ion-pair is shown to be closely related to that of an isolated positively charged particle whose mass is equal to the geometric mean of the ion and electron masses. Equations for the energy transferred from the field to the ion-pair are also derived. (Contractor's abstract)

1103

Litton Industries. Space Research Labs., Beverly Hills, Calif.

TWO-FLUID MODEL FOR THE MOTION OF A RARIFIED PLASMA ACCELERATED BY INDUCTION, by A. [S.] Penfold. Feb. 1, 1961 [25]p. incl. diagrs. (Publication no. 1456; technical memo. no. 10) (Bound with its AFOSR-64-1340; AD 609482, as Appendix E) (AF 49(638)759) AD 255042 Unclassified

Presented at Fifteenth annual meeting of the Amer. Rocket Soc., Washington, D. C., Dec. 5-8, 1960.

A single particle model has been devised in order to predict certain behavioral characteristics of plasmas. In the absence of coulomb forces, the motion of each ion and electron in the plasma is governed solely by its interaction with the applied magnetic field. When strong coulomb forces are applied, the plasma approaches macroscopic neutrality. A number of examples are given for the special case of a uniform field in the z-direction.

1104

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

DEFLAGRATION LIMITS IN THE STEADY LINEAR BURNING OF A MONOPROPELLANT WITH APPLICATION TO AMMONIUM PERCHLORATE, by W. E. Johnson and W. Nachbar. Aug. 1960 [35]p. incl. diagrs. table, refs. (Rept. no. LMSD-703060) (AFOSR-TN-60-700) (AF 49(638)412) AD 243489 Unclassified

Presented at Second AFOSR Contractors' meeting on Solid Propellant Combustion, Atlantic Research Corp., Alexandria, Va., June 7-8, 1960. (AFOSR-TN-60-663; AD 239150)

Also published in Eighth Symposium (Internat'l.) on Combustion, California Inst. of Tech., Pasadena (Aug. 28-Sept. 3, 1960), Baltimore, Williams and Wilkins Co., 1962, p. 678-689. (AFOSR-TR-60-127)

An analytical model for the steady, linear burning of a monopropellant is employed to describe the results of experiments on the burning of pressed, pure ammonium perchlorate pellets. Upper and lower bounds for the eigenvalue of the mathematical problem are derived. These bounds are convenient to use for numerical computations, and they afford a rigorous estimate of the approximation error. In following the hypothesis that the low-pressure deflagration limit (p_{DL}) observed in these experiments is due to radiant energy loss from the burning surface of the pellet, it is first demonstrated analytically that the model will also display a similar p_{DL} upon introduction of a term representing this loss. It is shown that, with reasonable numerical values, a good fit can be obtained from this theory to the experimental burning rate vs. pressure curve of pressures well above p_{DL}. However, the calculated value of p_{DL} due to surface radiant loss is much less than the observed value, and agreement with experiments is obtained only when an energy loss greater than that which can be presently accounted for is assumed. (Contractor's abstract)

1105

[London U. Coll.] Dept. of Anatomy (Gt. Brit.).

THE VISUAL SYSTEM OF OCTOPUS. (1) REGULARITIES IN THE RETINA AND OPTIC LOBES OF OCTOPUS IN RELATION TO FORM DISCRIMINATION, by J. Z. Young. [1960] [4]p. incl. illus. diagrs. table, refs. (AFOSR-2988, Pt. 1) [AF 61(052)256] Unclassified

Published in Nature, v. 186: 836-839, June 11, 1960.

The capacity of an octopus to learn to make distinct reactions to differing visible shapes depends largely upon analysis of the vertical and horizontal extents of the figures. The regularities now observed in the retina and optic lobes give clues to the mechanism for computing in these 2 directions: (1) Sufficient data are available to suggest that the shapes and anatomical arrangements of the optic lobe cells are of fundamental importance in the coding system. (2) Further examination of the outer segments of the retinal elements shows that the rhabdomes are orientated in the dorso-ventral and horizontal planes of the eye, as it is usually held with the pupil horizontal. A diagram is given of the probable arrangement of the retinal elements. (3) The process of the retinal receptors pass through a plexus, through a chiasma that inverts the display in the dorso-ventral plane, and end within the optic lobes mainly in a complicated plexiform layer, the deep retina. The features of the plexiform layer in Cajal and Golgi preparations are given and to provide regularities in the distribution of the dendrite in the layer. (4) The general similarity of the plan of organization of the visual system of octopus with that of insects and vertebrates serves the need for considering the form of the distribution of dendritic fields as a factor allowing coding by selection of particular features of an input.

1106

[London U. Coll.] Dept. of Anatomy (Gt. Brit.).

THE VISUAL SYSTEM OF OCTOPUS. (2) DISCRIMINATION OF POLARIZED LIGHT BY OCTOPUS, by M. F. Moody and J. R. Parriss. [1960] [2]p. incl. diagr. table. (AFOSR-2988, Pt. 2) [AF 61(052)256] Unclassified

Published in Nature, v. 186: 839-840, June 11, 1960.

An orientation experiment, carried out to show that the discrimination is intra-ocular and to determine whether the retina can give different responses to different directions of the plane of polarization, is described. The possibility that (1) the receptors have only two characteristic directions; or (2) there are receptors with more than 2 characteristic directions is discussed.

1107

London U. Coll. [Dept. of Chemistry] (Gt. Brit.).

THE CALCULATION OF BASIS ATOMIC ORBITALS FOR MOLECULAR WAVE FUNCTIONS, by D. P. Craig and C. Zauli. 1960 [12]p. incl. diagrs. table. (AFOSR-3803) (AF 61(052)61) Unclassified

Also published in Gazzetta Chim. Ital., v. 90: 1700-1711, 1960.

In molecular problems, free-atom values are usually taken for the parameters of the atomic orbitals which are combined to form antisymmetric molecular wave functions. This procedure fails for outer d orbitals in certain cases and is always objectionable in principle. By making a preliminary variation calculation to determine atomic parameters in a wave function without exchange, improved values are obtained which may then be employed in more accurate molecular wave functions, in partial analogy with the procedure in the self-consistent field method for atomic wave functions. The technique is illustrated in a calculation of the exponential parameters for 3d orbitals in the molecular field produced by fluorine atoms in a variety of spatial configurations. Orbitals directed towards the ligands are preferentially perturbed; and in agreement with earlier estimates by Craig and Magnusson, the exponents of the orbitals are in some cases increased to several times their free atom values. (Contractor's abstract)

1108

London U. Coll. Dept. of Chemistry (Gt. Brit.).

EVALUATION OF MOLECULAR INTEGRALS BY A NUMERICAL METHOD, by E. A. Magnusson and C. Zauli. [1960] [12]p. incl. tables, refs. (AFOSR-3892) (AF 61(052)61) Unclassified

Also published in Proc. Phys. Soc. (London), v. 78: 53-64, 1961.

Numerical integration in elliptical coordinates is proposed as a convenient method for the computation of most types of 2-electron molecular integrals including some types of 3- and 4-center integrals, and in some cases, of 1-electron 2- and 3-center integrals. This method removes a great deal of the burden of analysis and in addition lifts many of the restrictions on the form of the orbitals which are imposed by existing methods. For Slater-type orbitals general formulae are given to facilitate the calculation of 2-center Coulomb integrals, hybrid repulsion integrals and certain 3-center integrals. Explicit expressions are listed for integrals involving orbitals of the first, second, and third quantum shell. (Contractor's abstract)

1109

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

THE FLOW OF POLYCRYSTALLINE METALS UNDER SIMPLE SHEAR. II, by E. N. da C. Andrade and K. H. Jolliffe. Final rept. Jan. 1960 [32]p. incl. illus. diagrs. tables, refs. (AFOSR-TR-60-54) (AF 61(514)1177) AD 236308 Unclassified

Also published in Proc. Roy. Soc. (London), v. 254A; 291-316, Feb. 1960.

The flow of samples of Pb of different purity under conditions of simple shear was investigated over a wide range of strain. The phenomena were studied with the direction of stress both unchanged and reversed during flow. At the beginning of forward creep the $t^{1/3}$ law is strictly obeyed, within a range of strain which is determined by the purity and grain size of the Pb. The region within which the $t^{1/3}$ law holds, (stage F-I) is succeeded by stage F-II, during which the strain increases according to a logarithmic law, the creep rate being proportional to the increase in strain. For stage F-III, which begins at a strain of 0.3, the creep is linear until it approaches 2.0 where rupture starts. Reversing stress while stage F-I is in progress results in a creep linear with time, at a rate twice that of the forward creep at the moment of reversal; this constant rate continues for a time equal to that of the forward creep. If the stress is reversed at a strain invalidating the $t^{1/3}$ law, the reverse creep stages are markedly affected. Photomicrographs and x-ray photographs show that the $t^{1/3}$ flow is accompanied by progressive slip in the grains and local rotation of the lattice, and that in the R_0 stage (reversal) slip occurs on the same slip bands as were active in the F-I stage. Recrystallization and grain growth occur during stages F-II and R-II. In stages F-III and R-III there is a balance between grain break-up and grain growth, the slip direction tends to the directions of principal stresses. (Contractor's abstract, modified)

1110

London U. Inst. of Laryngology and Otology (Gt. Brit.).

THE SECRETION AND ABSORPTION OF ENDOLYMPH, by G. Dohlman and F. C. Omerod. [1959] [4]p. incl. illus. (AFOSR-TN-60-1317) [AF 61(052)-271] AD 246182 Unclassified

Also published in Acta Oto-laryngol., v. 51: 435-438, 1959.

Experiments are reported on in which radioactive sulphur (S^{35}) is utilized to follow the fate of mucopolysaccharides in the living animal ear. The substance disappears rapidly from the secretory epithelium, the cupula and the otolithic membranes. It is reported that in the distal half of the ductus endolymphaticus, a thrombus-like mass, apparently coagulated with protein-mucopolysaccharides with a considerable concentration of S^{35} can be detected. Radioactive sulphur is also found in the mass of vascularized connective tissue in the extradural space. There are many signs of relatively strong radioactivity in the connective tissue surrounding the inner parts of the duct. This represents the radioactive sulphur molecules which appear to have penetrated the wall of the duct and presumably indicate the cellular absorption, from the endolymph, of organic substances containing sulpholucopolysaccharides. The investigations indicate that the important constituents of vestibular and cochlear metabolism are secreted in the appropriate epithelium in the cochlea, ampulla, utricle and saccule. There is no evidence that the mucopolysaccharides enter into any part of the sensory epithelium.

1111

London U. Inst. of Laryngology [and Otology] (Gt. Brit.).

A THEORY OF ECHOLOCATION BY BATS, by J. D. Pye. [1960] [12]p. incl. illus. diagrs. refs. (AFOSR-377) [AF 61(052)271] AD 254448 Unclassified

Also published in Jour. Laryngol. and Otol., v. 74: 718-729, Oct. 1960.

This theory shows that it is possible to obtain a considerable amount of information from a frequency analysis of beats between a bat's call and its echo. Whether the emitted frequency is constant or changing, any object within range will appear to act as a source of different sounds whose nature is determined by the instantaneous or changing position of the object relative to the bat. Pumphrey argued that hearing, whatever it may have become in man, developed as a sense of touch at a distance whose primary function is the location of sound sources. The bat has gained independence

by radiating energy itself to include passive objects. If it listens to beat notes it has changed the information code but increased enormously its powers of discrimination. Experiments will be made to test this theory with bats, but it has already been shown to be applicable to the human ear. A simple model generating bat-like sounds and receiving the echoes through non-linear amplifiers presents the listener with audible beat notes. The information available is readily interpreted by the ear when the machine is operated in any of 3 modes or in a combination of them. This device may possibly form the basis for a useful aid to the blind since it has many advantages over previous ultrasonic aids. (Contractor's abstract)

1112

London U. Inst. of Laryngology and Otology (Gt. Brit.).

THE PHYSIOLOGY OF THE ENDOLYMPH, by F. C. Ormerod. [1960] [9]p. incl. illus. (AFOSR-500) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)271] and Leverhulme Trustees) AD 254441 Unclassified

Presented at meeting of the Roy. Soc. Med., Otological Section, London, Feb. 5, 1960.

Also published in Jour. Laryngol. and Otol., v. 74: 659-667, Sept. 1960.

It has been demonstrated that radioactive sulphur injected into the semicircular canal ampulla of the pigeon replaced that in the sulphomucopolysaccharides of the endolymph by passing from the secretory epithelium to the cupula. The present paper continues this type of study throughout the rest of the inner ear. It is noted that in the cochlea and saccule the sulphur crosses the endolymph to the tectorial and otolith membranes respectively with little becoming impregnated in the neuroepithelium. This is the general path taken by the sulphur in the 4 parts of the internal ear being studied. It is shown that the sulphomucopolysaccharides is closely associated with the function of the sense organ and its penetration into the meshwork of the cupula or other membranes indicates the importance of these structures for the mechanism of stimulation of the sensory cells. The endolymph provides mucopolysaccharides and probably protein for the maintenance of the proper function of the sense organ. The tectorial and other membranes appear to be the seat of the most important functions and it is possible that the transduction of mechanical energy into changes of electric potential takes place in these structures and is the locus where the hairs of the sensory cells fit into the tubules in the meshwork of the membrane. The membrane charge is negative and that of the sensory cells and hairs positive. Since the limiting membrane between them is impermeable, every change of electrical potential on the surface of the hairs causes a corresponding change in the charge of the cell. This change is transmitted to the nerve elements.

1113

London U. Queen Mary Coll. (Gt. Brit).

ON SUBSTITUTION OPERATORS. I. A SUMMATION METHOD, by G. I. Targonski. Final rept. Nov. 25, 1960, 17p. (AFOSR-363) (AF 61(052)320) AD 254366 Unclassified

A special class of operators is investigated. Invariants and eigenfunctions are constructed. Arbitrary functions are expanded in terms of eigenfunctions: this is used as a method of solving functional equations. In the first part of the work, the solution of a particular type of functional equation renders a group of integral representations for function series. (Contractor's abstract)

1114

Long Island Biological Assoc., Inc., N. Y.

COLD SPRING HARBOR SYMPOSIA ON QUANTITATIVE BIOLOGY. VOL. XXV. BIOLOGICAL CLOCKS, Cold Spring Harbor, N. Y. (June 5-14, 1960), New York, Long Island Biological Assoc., Inc., 1960, 524p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF-AFOSR 60-4, Carnegie Corp., Inst. of Oceanography and Marine Biology, National Science Foundation, Office of Naval Research, Public Health Service, and Rockefeller Foundation) Unclassified

This symposium reflects the marked increase of interest in biological clocks. This growth of interest is due almost entirely to the elegant experimental demonstrations that birds, bees, and many other animals orient or navigate using the position of the sun as a guidepost, and compensating for its movement in time with the use of an internal chronometer. Rapid advances have been seen in studies of rather diverse phenomena in a wide variety of organisms from single cells through higher plants and animals. In these meetings, circadian rhythms are treated from various aspects, i.e., the metabolic aspects of circadian rhythms, models for circadian rhythms, photo- and thermo-periodism effects, physiological factors, ecological patterns, etc.

Lorentz Inst., Leyden (Netherlands).
see Leyden U. Lorentz Inst. (Netherlands).

1115

Louvain U. Lab. for Inorganic [and Analytical] Chemistry, (Belgium).

NEW DEVELOPMENTS OF A KINETICAL STUDY OF FLAMES, by A. Van Tiggelen, R. Corbeels and others. Feb. 1961, 64p. incl. diagrs. tables. (Technical note no. 3) (AFOSR-TN-60-1210) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)1245 and Fonds de la Recherche Scientifique (Belgium)) AD 254500 Unclassified

Theoretical introduction: Two developments of the theory of flame propagation are presented; they concern first, the order, with respect to fuel and oxidizer of the branching process in the flame, and secondly, the problem of flames propagating in ternary mixtures (2 fuels and 1 oxidizer). Kinetical parameters in methane-nitrous oxide flames: Flames propagating in methane-nitrous oxide mixtures have been investigated. These flames do not behave in the same manner as the more classical flames: the reaction order is one with respect to fuel and also one to oxidizer. This means that a total order is observed here which is one unit higher than for the methaneoxygen flames. Burning velocities in ternary ethylene, vinylchloride and oxygen mixtures: The properties of the flames sustained by ternary mixtures of ethylene, vinylchloride and oxygen have been studied. The activation energy of the branching process calculated from the experimental data, varies continuously from the value found for pure ethylene-oxygen flames to the value observed for pure vinylchloride-oxygen flames while the fraction of vinylchloride content varies from zero to unity. However this variation is not exactly what should be expected in the absence of some inhibition effect due to the presence of the halogen. (Contractor's abstract)

1116

Louvain U. [Lab. for Inorganic and Analytical Chemistry] (Belgium).

CHEMICAL KINETICS IN FLAME PROCESSES (Abstract), by A. Van Tiggelen. [1960] [1]p. (AF 61-(514)1245) Unclassified

Presented at First AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, General Dynamics Corp., General Atomic Div., San Diego, Calif., Sept. 6-7, 1960. (AFOSR-TN-60-1063; AD 246174)

The classical chemical parameters which appear in the square root law for burning velocity are determined. By measuring laminar burning velocities and flame temperatures in various types of mixtures at different degrees of dilution and preheating temperatures, it has been possible to determine the E_{act} and in some cases the reaction orders with respect to the fuel and the oxidizer concentrations. A complete knowledge of the kinetical parameters have been made available for the following flames: CH_4/O_2, C_2H_2/O_2, N_2H_4 oxidation and decomposition flames, and CH_4/N_2O. Mixtures which contain either one fuel and two different oxidizers or one oxidizer and two different fuels have been investigated. Inhibition or promotion may occur which depend on the reaction mechanism in the binary mixtures and also on the occurrence of some interference. Three fundamental parameters are considered in order to explain any promotion or inhibition effect in these mixtures: the overall branching probability, the mean molecular weight of the chain carriers, and the probability of chain termination.

1117

Lund U. Dept. of Pharmacology (Sweden).

MOTOR END-PLATE "DESENSITIZATION" BY REPETITIVE NERVE STIMULI, by S. Thesleff. [1959] [6]p. incl. diagrs. refs. (AFOSR-TN-60-422) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)106], Muscular Dystrophy Associations of America, Inc., and Swedish Medical Research Council) AD 241996 Unclassified

Also published in Jour. Physiol., v. 148: 659-664, June 1959.

Experiments were conducted to show the effect of repetitive nerve stimulation and account for the neuromuscular block that accompanies the stimulation. The experiments were made on the isolated rat phrenic-diaphragm preparation kept at 30-35°C, stimulated indirectly by square-wave pulses of 0.1 msec duration. A 3M solution of acethycholine (ACh) was prepared. It is shown that repetitive nerve stimulation renders the end-plate refractory to applied ACh and that the receptor desensitization has such an intensity that it can account for a neuromuscular block. It is concluded that desensitization of end-plate receptors is produced by the transmitter agent and that it can account for the decline in amplitude of successive end-plate potentials. Furthermore, the desensitization process is likely to be at least partly responsible for the neuromuscular transmission failure known as Wedensky inhibition.

1118

Lund U. Dept. of Pharmacology (Sweden).

EFFECTS OF MOTOR INNERVATION ON THE CHEMICAL SENSITIVITY OF SKELETAL MUSCLE, by S. Thesleff. [1960] [19]p. incl. diagrs. refs. (AFOSR-TN-60-483) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)106, Muscular Dystrophy Associations of America, Inc., and Swedish Medical Research Council) Unclassified

Also published in Physiol. Rev., v. 40: 734-752, Oct. 1960.

A description of the effects of reduced motor nerve activity on the chemical sensitivity of skeletal muscle was presented. It was shown that when a muscle fiber was deprived of its innervation the ACh-sensitive region at the end plate increased in size until it ultimately covered the whole muscle surface. Results obtained in muscles treated with botulinum toxin demonstrated that it was primarily a lack of transmitter release and not nerve degeneration that was responsible for the increase in size of the chemosensitive area. Furthermore, studies of ACh-sensitivity in fetal and newborn rat muscle revealed that the muscle fibers prior to a functional innervation were sensitive to the drug along their whole length. These findings suggest that a skeletal muscle, at a early stage of innervation or when denervated, is uniformly sensitive to ACh on its

entire surface. The application of ACh or repetitive motor nerve stimulation reversibly reduces the chemical sensitivity of existing ACh-receptors. (Contractor's abstract, modified)

1119

Lund U. Dept. of Pharmacology (Sweden).

A STUDY OF ACETYLCHOLINE INDUCED CONTRACTURES IN DENERVATED MAMMALIAN MUSCLE, by D. Elmqvist and S. Thesleff. [1960] [10]p. incl. diagrs. table, refs. (AFOSR-TN-60-1421) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)106] and Muscular Dystrophy Associations of America, Inc.) AD 246884 Unclassified

Also published in Acta Pharmacol. et Toxicol., v. 17: 84-93, 1960.

The relationship between the size of the acetylcholine (ACh) sensitive area and the magnitude of ACh induced contractures was investigated in the isolated and chronically denervated rat diaphragm muscle. A close correlation was observed between the length of the ACh-sensitive region in muscle fibers and their maximal shortening in response to applied ACh. This suggests that ACh induced isotonic contractures may be used as a simple method for determining the size of the ACh-sensitive surface in denervated muscles. After denervation, the diaphragm muscle responded quantitatively to ACh by graded and readily reproducible contractures. Dose-response curves to ACh in the presence of tubocurarine suggest that the preparation is well suited for pharmacological studies of ACh-receptor reactions and of drug antagonism. (Contractor's abstract)

1120

Lund U. Dept. of Pharmacology (Sweden).

SUPERSENSITIVITY OF SKELETAL MUSCLE PRODUCED BY BOTULINUM TOXIN, by S. Thesleff. [1960] [14]p. incl. illus. diagrs. tables, refs. (AFOSR-TN-60-1422) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)106] and Muscular Dystrophy Associations of America, Inc.) AD 246885 Unclassified

Also published in Jour. Physiol., v. 151: 598-607, June 1960.

In mammalian skeletal muscle intoxicated by botulinum the entire muscle membrane becomes sensitive to applied acetylcholine. One to 2 wk after the administration of the toxin the whole surface of the muscle is uniformly sensitive to acetylcholine. The spread of acetylcholine sensitivity from the end-plate to the whole membrane occurs in a similar manner and with about the same time course as in a chronically denervated muscle. Botulinum toxin prevents transmitter release from motor nerve terminals without altering their ultrastructure. The present results indicate that the toxin acts by blocking the mechanism responsible for transmitter release from cholinergic endings. It is suggested that transmitter release from motor nerve terminals determines the size of the acetylcholine-sensitive area in the post-junctional membrane and that lack of transmitter agent and not nerve degeneration is responsible for initiating the process which leads to a high and uniform chemo-sensitivity in chronically denervated or botulinum-treated muscles. (Contractor's abstract)

1121

Lund U. Dept. of Pharmacology (Sweden).

A STUDY OF SOME ELECTROPHYSIOLOGICAL PROPERTIES OF HUMAN INTERCOSTAL MUSCLE, by D. Elmqvist, T. R. Johns, and S. Thesleff. [1960] [6]p. incl. illus. diagr. tables. (AFOSR-607) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)106], Muscular Dystrophy Associations of America, Inc., and Public Health Service) AD 258608 Unclassified

Published in Jour. Physiol., v. 154: 602-607, Dec. 1960.

The electrophysiological properties of normal human skeletal muscle are compared to those of other mammalian species. The spontaneous subthreshold activity at the myoneural junction was studied, and the membrane constants of the muscle fibers are determined. Human intercostal muscles proved to be excellent preparations for studies in vitro. The electrophysiological properties of human muscles are similar to those of other species, except that the frequency of miniature end-plate potentials (0.2/sec) is considerably lower, and the membrane resistance is higher. The transverse resistance of the fiber membrane was about 4000 $\Omega\,cm^2$ and the membrane capacitance varied between 3-6$\mu F/cm^2$.

1122

Lund U. Dept. of Pharmacology (Sweden).

IN VIVO UPTAKE OF DOPAMINE AND 5-HYDROXYTRYPTAMINE BY ADRENAL MEDULLARY GRANULES, by A. Bertler, A. M. Rosengren, and E. Rosengren. [1960] [2]p. incl. table, refs. (AFOSR-TN-60-1048) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)247] Lund U. Medical Faculty, and Swedish Medical Research Council) AD 257545 Unclassified

Also published in Experientia, v. 16: 418, Sept. 15, 1960.

An investigation of the uptake of catechol amines by the catechol amine containing granules after the administration of 3,4-dihydroxyphenylalanine (DOPA) is reported. DOPA is decarboxylated to dopamine by the enzyme DOPA-decarboxylase. The granular fraction from centrifugal preparations contained 3.7μg dopamine 30 min after the administration of DOPA, whereas less than 1 μg was localized in the cytoplasmic sap. The newly-formed dopamine is thus rapidly taken up

by the granules. In the kidney cortex, which is rich in DOPA-decarboxylase but lacks catechol amine storing granules, most of the dopamine was found in the cytoplasmic sap. Pretreatment of the animals with reserpine impaired the uptake of dopamine by adrenal medullary granules after DOPA administration. Thus the primary effect of reserpine which is known to deplete the body stores of catechol amines may be its interaction with the uptake of catechol amines by the granules.

1123

Lund U. Dept. of Pharmacology (Sweden).

STORAGE OF NEW-FORMED CATECHOLAMINES IN THE ADRENAL MEDULLA, by A. Bertier, N. A. Hillarp, and E. Rosengren. [1960] 4p. incl. diagrs. (AFOSR-TN-60-1050) (AF 61(052)247) AD 257546 Unclassified

Also published in Experientia, v. 16: 419-420, Sept. 15, 1960.

Evidence is presented in support of the view that dopamine (DA) and noradrenaline (NA) are in fact incorporated in the amine granules which normally store only adrenaline (A) in the suprarenal medulla of the rabbit. The data show that reserpine may prevent newly formed DA and NA from becoming particle bound. This result, thus, further supports the conclusion that these amines - after dopa administration to normal animals - are incoporated in the specific storage granules. This storage mechanism is observed to be very efficient. Furthermore, it is not specific for A alone since it cannot choose between DA, NA, and A.

1124

Lund U. Dept. of Pharmacology (Sweden).

ARE DIHYDROXYPHENYLALANINE DECARBOXYLASE AND 5-HYDROXYTRYPTOPHAN DECARBOXYLASE INDIVIDUAL ENZYMES? by E. Rosengren. [1960] 6p. incl. diagrs. table, refs. (AFOSR-608) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)247], Lund U. Medical Faculty, and Swedish Medical Research Council) AD 257548 Unclassified

Also published in Acta Physiol. Scand., v. 49: 364-369, Aug. 25, 1960.

Using an enzyme preparation from rabbit kidney cortex, the amino acids 3,4-dihydroxyphenylalanine and 5-hydroxytryptophan were found to competitively inhibit each other's enzymatic decarboxylation. Competitive inhibitions of these reactions by m-tyrosine, o-tyrosine, and caffeic acid were also observed. After purification of an enzyme preparation on a column of DEAE cellulose a peak appeared which contained most of the dihydroxyphenylalanine decarboxylase activity present in the extract. In this peak also nearly all the 5-hydroxytryptophan decarboxylase activity was found. The ratio of the 2 activities was practically the same throughout the peak. The data were in agreement with the assumption that 5-hydroxytryptophan were decarboxylated by 1 enzyme. (Contractor's abstract)

1125

Lund U. Dept. of Pharmacology (Sweden).

ON THE ROLE OF MONOAMINE OXIDASE FOR THE INACTIVATION OF DOPAMINE IN BRAIN, by E. Rosengren. [1960] 6p. incl. diagrs. table, refs. (AFOSR-610) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)247], Lund U. Medical Faculty, and Swedish Medical Research Council) AD 257549 Unclassified

Also published in Acta Physiol. Scand., v. 49: 370-375, Aug. 25, 1960.

Evidence is presented that monoamine oxidase is involved in the metabolism of dopamine in brain. Thus 3,4-dihydroxyphenylacetic acid has been demonstrated to occur in the brains of 3 species investigated, including man. That this acid was derived from dopamine after oxidative deamination seemed probably as it was found to be localized in the same areas of the brain as dopamine and it disappeared after inhibition of monoamine oxidase with iproniazid. The capacity of this enzyme in brain seemed to be sufficient for the plausible inactivation rate of dopamine in this tissue. (Contractor's abstract)

1126

Lund U. Dept. of Pharmacology (Sweden).

INTRACELLULAR LOCALIZATION OF DOPAMINE IN COW INTESTINE, by A. Bertler, N. A. Hillarp, and E. Rosengren. [1960] [4]p. incl. diagrs. refs. (AFOSR-803) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)247, Lund U. Medical Faculty, and Swedish Medical Research Council) AD 257550 Unclassified

Also published in Acta Physiol. Scand., v. 50: 84-87, Sept. 15, 1960.

In previous investigations a certain type of chromaffin cells containing dopamine has been demonstrated to occur in ruminant tissues. It seemed likely that dopamine in these cells was held in intracellular particles in a similar manner as noradrenaline and adrenaline in the adrenal medulla. In this study the intracellular distribution of dopamine in the cow intestine which contains high amounts of this amine, was studied. Some factors affecting this distribution have also been included. (Contractor's abstract)

1127

Lund U. Dept. of Pharmacology (Sweden).

OCCURRENCE AND LOCALIZATION OF CATECHOL AMINES IN THE HUMAN BRAIN, by A. Bertler. [1960] 11p. incl. diagrs. tables, refs. (AFOSR-804)

(Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)247, Lund U. Medical Faculty, and Swedish Medical Research Council)
AD 257551 Unclassified

Also published in Acta Physiol. Scand., v. 51: 97-107, 1961.

The content of noradrenaline, dopamine and 5-hydroxytryptamine (5-HT) in various structures of the human brain was investigated. Noradrenaline in rather high concentrations was found in the anterior and middle portion of the hypothalamus, and lower levels were recorded in structures of the mesencephalon and the floor of the 4th ventricle. Dopamine showed a very strict localization to structures which are involved in the extrapyramidal system, i. e. the basal ganglia and the substantia nigra suggesting that it may be involved in the function of this system. Relatively high concentrations of 5-HT were found in the hypothalamus, the medulla oblongata, the corpus striatum and the thalamus. (Contractor's abstract)

1128

Lund U. Dept. of Pharmacology (Sweden).

SOME OBSERVATIONS ON THE SYNTHESIS AND STORAGE OF CATECHOLAMINES IN THE ADRENALINE CELLS OF THE SUPRARENAL MEDULLA, by A. Bertler, N. A. Hillarp, and E. Rosengren. [1960] [8]p. incl. tables, refs. (AFOSR-805) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)247, Lund U. Medical Faculty, and Swedish Medical Research Council) AD 257552 Unclassified

Also published in Acta Physiol. Scand., v. 50: 124-131, Oct. 31, 1960.

The intracellular distribution of dopamine, noradrenaline and adrenaline in rabbit suprarenal glands was examined by differential centrifugation of homogenates (0. 3 M sucrose) of the medullary tissue. The amines were determined spectrophoto-fluorimetrically. Glands from normal animals were found to contain no, or very small amounts of dopamine and noradrenaline. When the medulla was stimulated to secretion by insulin-induced hypoglycemia, noradrenaline was rapidly formed. It accumulated in the large granule fraction, but largely disappeared together with the adrenaline store on prolonged stimulation. Large amounts of bound noradrenaline again accumulated during the recovery phase. Very large amounts of dopamine and noradrenaline rapidly (within 30 min) appeared after an intravenous injection of L-dopa (100 mg/kg body wt). The new-formed amines became rapidly particle-bound. In contrast to dopamine which largely disappeared after some hr the noradrenaline remained in large amount for at least 24 hr. A tentative scheme of the intracellular events which occur when the adrenaline cell synthesizes and stores catecholamines is proposed and discussed. (Contractor's abstract)

1129

Lund U. Dept. of Pharmacology (Sweden).

"BOUND" AND "FREE" CATECHOLAMINES IN THE BRAIN, by A. Bertler, N. A. Hillarp, and E. Rosengren. [1960] [6]p. incl. tables, refs. (AFOSR-806) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)247, Lund U. Medical Faculty, and Swedish Medical Research Council)
AD 257553 Unclassified

Also published in Acta Physiol. Scand., v. 50: 113-118, Oct. 31, 1960.

The major portion of the noradrenaline in the rabbit hypothalamus was recovered in the particulate fraction of homogenates in 0. 3 M sucrose. In contrast to this, the dopamine in the caudate nuclei of rabbit and cat was to the largest part found in the high-speed supernatant. The amine distribution did not seem to be materially influenced by the use of different homogenization media. Neither were any obvious changes in the distribution seen after administration of iproniazid or reserpine. The dopamine formed in the hypothalamus after an injection of L-dopa was found to be particle-bound to a rather large extent. (Contractor's abstract)

1130

Lund U. Dept. of Pharmacology (Sweden).

EFFECT OF RESERPINE ON THE STORAGE OF CATECHOL AMINES IN BRAIN AND OTHER TISSUES, by A. Bertler. [1960] [9]p. incl. diagrs. table, refs. (AFOSR-807) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)247, Lund U. Medical Faculty, and Swedish Medical Research Council) AD 257554 Unclassified

Also published in Acta Physiol. Scand., v. 51: 75-83, Jan. 1961.

The effect of reserpine on the metabolism of dopamine and noradrenaline in tissues was studied. Dopamine was found to be depleted from the brain at a higher rate than noradrenaline; dopamine decreased to 50% of the normal level in 15 min while the corresponding time interval for noradrenaline was 45 min. The dopamine in the peripheral tissues of the sheep was found to be only slightly lowered within 13 hr, after administration of 2 and 4 mg reserpine per kg whereas the dopamine of the brains were reduced to insignificant amounts. In this respect it behaved in the same way as 5-hydroxytryptamine. The rate of disappearance of catechol amines after reserpine is suggested to be dependent on the rate of turn over of the amines. The principal effect of reserpine on the tissue catechol amines and 5-hydroxytryptamine is supposed to be due to an interaction of the active transport of the amines into the storage sites. The results of the investigation indicate that the drug does not interfere with the decarboxylation of dihydroxyphenylalanine and 5-hydroxytryptophan. (Contractor's abstract)

1131

Lund U. Dept. of Pharmacology (Sweden).

ON THE BIOCHEMISTRY AND POSSIBLE FUNCTIONS OF DOPAMINE AND NORADRENALINE IN BRAIN, by A. Carlsson, M. Lindqvist, and T. Magnusson. [1960] [8]p. incl. diagrs. refs. (AFOSR-1038) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)247] and Swedish Medical Research Council) Unclassified

Also published in Adrenergic Mechanisms; Proc. of Ciba Foundation Symposium, London (Gt. Brit.) (Mar. 28-31, 1960), Boston, Little, Brown and Co., 1960, p. 432-439.

The accumulation of catechol amines and their O-methylated metabolites in brain following monoamine oxidase inhibition has been studied. Evidence of a rapid turnover of the brain catechol amines is presented. The biosynthesis of catechol amines and 5-hydroxytryptamine seems to slow down as soon as the amines accumulate beyond the maximum capacity of the storage mechanism. Observations on the behavior of the animals support the view that the brain catechol amines are involved in the control of psychomotor activity. (Contractor's abstract)

1132

Lund U. Dept. of Physics (Sweden).

PHOTOMETRIC CHARGE DETERMINATION OF RELATIVISTIC HEAVY PRIMARIES IN COSMIC RADIATION, by B. Waldeskog and O. Mathiesen. June 1960 [14]p. incl. diagrs. tables, refs. (Technical note no. 1[A]) (AFOSR-TN-60-1469) (Sponsored jointly by [Air Force Office of Scientific Research under AF 61(052)116] and Office of Naval Research) AD 253279 Unclassified

Also published in Arkiv för Fysik, v. 17: 427-440, 1960.

A photometric method of determining the charge of relativistic heavy primary particles in photographic emulsions is described. Corrections for different emulsion effects are applied. The accuracy of the charge determination in the interval $3 \leq Z \leq 14$ is very good. The standard error corresponds to about 1/5 of the distance between consecutive charges. The method may also be used for higher charges. For studies in the above interval in emulsions flown over Texas at 41° geomagnetic latitude the mean flight altitude was about 29 km corresponding to 14 g/cm^2 overlying atmosphere. The charge calibration is made by δ-ray counting and by studies of fragmentation of heavy nuclei in the emulsion. An extrapolation of the number of boron particles to the top of the atmosphere shows that there exists a finite flux of these particles in the primary beam. The abundance ratio N_{Boron}/N_M falls in the interval 0.13 to 0.25, depending on the fragmentation probabilities used for the extrapolation. The results further show that the relative frequency of nitrogen nuclei is small compared with the frequency of carbon and oxygen nuclei. These nuclei occur in comparable amounts. (Contractor's abstract)

1133

Lund U. Dept. of Physics (Sweden).

DETERMINATION OF THE CHARGE OF RELATIVISTIC HEAVY PRIMARIES IN COSMIC RADIATION BY δ-RAY COUNTING AND A COMPARISON WITH PHOTOMETRIC IDENTIFICATION, by O. Mathiesen. June 1960 [14]p. incl. diagrs. tables, refs. (Technical note no. 1[B]) (AFOSR-TN-60-1470) (Also bound with its AFOSR-TN-60-1469; AD 253279) [AF 61(052)116] Unclassified

Also published in Arkiv för Fysik, v. 17: 441-454, 1960.

A charge determination of relativistic heavy primaries in the cosmic radiation was undertaken by determining the δ-ray density, N_δ, of tracks in nuclear emulsions. The investigation was restricted to particles with well identified charges in the interval $2 \leq Z \leq 10$, which made it possible to examine the applicability of δ-ray counting in this region. The standard error in N_δ was found to be greater than expected from purely statistical fluctuations, the coefficient of variation introduced by other sources of error than statistical ones being 7%. Possible sources of error, which may explain this increase are discussed as well as different psychological factors, which affect the reproducibility. The relation between N_δ and Z^2 is found to be linear. The results obtained from the δ-ray counting are compared with photometric measurements and with other charge spectra based on δ-ray counting. (Contractor's abstract)

1134

Lund U. Dept. of Physics (Sweden).

THE ABUNDANCE OF NUCLEI HEAVIER THAN OXYGEN IN THE PRIMARY COSMIC RADIATION, by K. Kristiansson, O. Mathiesen, and B. Waldeskog. June 1960 [29]p. incl. diagrs. tables, refs. (Technical note no. 1[C]) (AFOSR-TN-60-1471) (Also bound with its AFOSR-TN-60-1469; AD 253279) (Sponsored jointly by Air Force Office of Scientific Research under AF 61-(052)116 and Office of Naval Research) Unclassified

Also published in Arkiv för Fysik, v. 17: 455-483, 1960.

Photometric measurements were made on 61 tracks of heavy primary particles ($Z > 8$), which were found in an emulsion stack exposed over Texas at 41° geomagnetic latitude. The measurements were corrected for different emulsion effects. The tracks were selected according to a track length criterion which states that the tracks to be accepted must be long enough to give a standard error in the determination of the charge

not exceeding 0.30 units of charge. The charge calibration was made by δ-ray counting and by studies of break-up events. A small amount of fast but non-relativistic particles were found in the material. These particles were identified from measurements of mean track width and rate of change of mean track width along the track. The spectrum shows well-resolved peaks. The following observations were made in the spectrum. The ratio $N(17 \geq Z \leq 26)/N(9 \leq Z \leq 16) = 0.48 \pm 0.14$ at the top of the atmosphere. The abundance of odd nuclei is much less than the abundance of even nuclei. Neon, magnesium, and silicon are the most abundant elements and occur with approximately the same frequency. There are few primary particles in the charge region $17 \geq Z \leq 23$. There are 2 comparatively large particle groups, namely, chromium and iron of roughly the same size in the very heavy region. No particles heavier than iron were found. The relative abundance of oxygen, silicon, and iron is discussed and compared with the mean universal abundance. (Contractor's abstract)

1135

Lund U. Dept. of Physics (Sweden).

IDENTIFICATION OF NON-RELATIVISTIC HEAVY PRIMARIES IN COSMIC RADIATION BY PHOTOMETRIC MEASUREMENTS IN NUCLEAR EMULSIONS, by K. Kristiansson, O. Mathiesen, and B. Waldeskog. June 1960 [9]p. incl. diagrs. (Technical note no. 1[D]) (AFOSR-TN-60-1472) (Also bound with its AFOSR-TN-60-1469; AD 253279) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)116 and Office of Naval Research) Unclassified

Also published in Arkiv för Fysik, v. 17: 485-493, 1960.

The possibility is discussed of determining the charge of a non-relativistic heavy primary particle by photometric measurements of mean track width (MTW) and the rate of change of mean track width along the track. The error in the charge determination is sensitive to the length of the track measured and the particle velocity. Correct identification is possible as soon as the total track length is greater than 25 mm and the momentum of the particle, p_z, is less than a value which depends on the charge. The limit is for magnesium $p_{12} \simeq 1.2$ gev/c per nucleon and for iron $p_{26} \simeq 1.5$ gev/c pernucleon. In an interval 1.2-1.7 gev/c per nucleon for magnesium and 1.5-2.0 gev/c per nucleon for iron the rate of change of MTW is too small to be used for identifications. If a particle falling in this interval is identified solely from MTW measurements the apparent charge will be one unit too high. For $p_{12} > 1.7$ gev/c per nucleon and $p_{26} > 2.0$ gev/c per nucleon correct identification is possible from the MTW value only. (Contractor's abstract)

1136

Lund U. Thermochemistry Lab. (Sweden).

A METHOD FOR MAINTAINING CONSTANT POWER DISSIPATION TO A CALORIMETER CIRCUIT OVER A WIDE TEMPERATURE INTERVAL, by K. Rosengren. Oct. 1, 1960 [6]p. incl. diagrs. table. (Technical note no. 4) (AFOSR-TN-60-1116) (AF 61(052)46) AD 254331; PB 155696 Unclassified

Also published in Rev. Scient. Instr., v. 32: 1264-1265, Nov. 1961. (Title varies)

An arrangement is suggested for measuring, with high precision, electrical power supplied to a calorimeter system across a varying resistance. The power introduced through the heater is kept nearly constant by a resistance in series, and the only operation during the heating time is to keep the energy source at constant voltage. (Contractor's abstract)

1137

Lund U. [Thermochemistry Lab.] (Sweden).

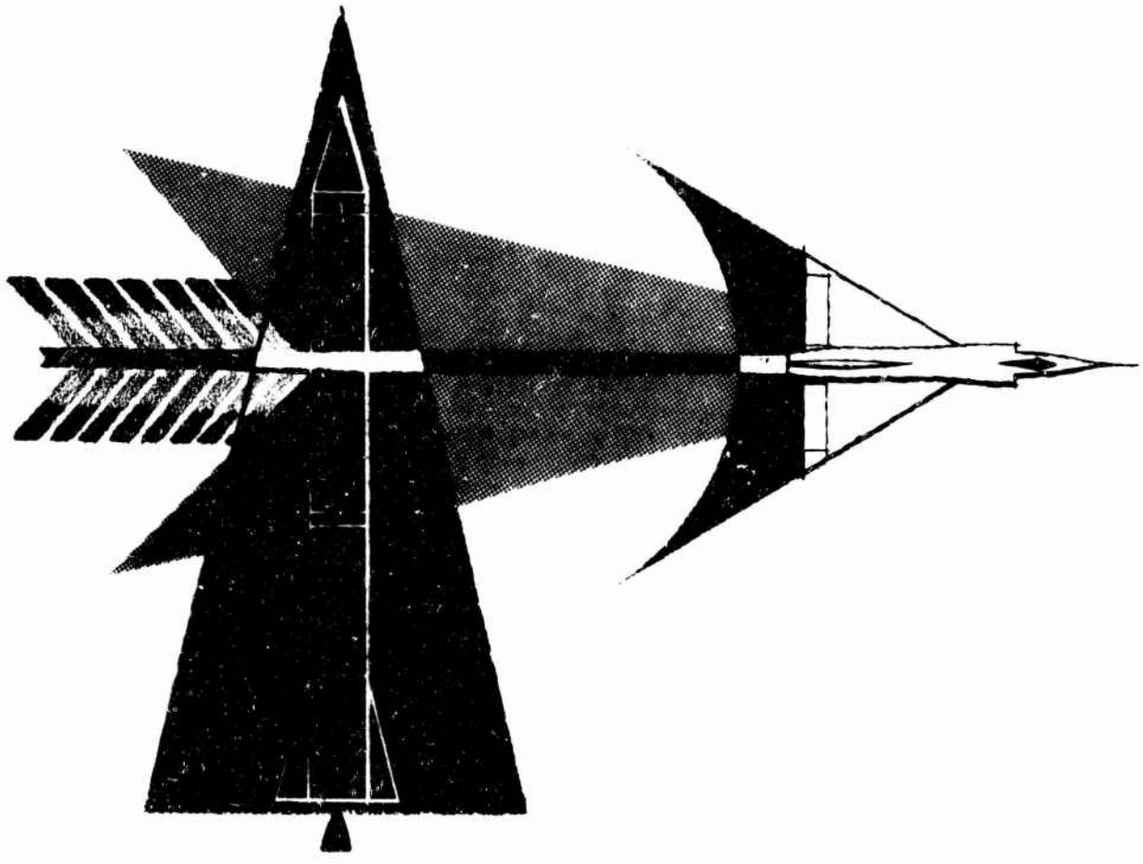
PHOTOLYSIS OF DISULFIDES IN MATRIX-FORMING MIXTURES OF HYDROCARBONS AT LIQUID NITROGEN TEMPERATURE AIMING AT THE DETERMINATION OF RADICAL RECOMBINATION ENERGIES (Abstract), by S. Sunner, K. Rosengren, and D. Timm. [1960] [2]p. (AF 61(052)48) Unclassified

Presented at First AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, General Dynamics Corp., General Atomic Div., San Diego, Calif., Sept. 6-7, 1960. (AFOSR-TN-60-1063; AD 246174)

The photolysis of disulfides in a mixture of 3-methylpentane and isopentane (3-PIP), is easily achieved and is a first order reaction. The disappearance of the disulfide has been followed by UV-spectrometry. During photolysis, a new absorption maximum appears, which, is not stable (in 3-PIP) at liquid nitrogen temperature indicating that the recombination reaction and competing reactions occur in the matrix. Upon warming, the amount of disulfide in the glass increases. In 3-PIP, about 10% of the photolysed amount is reformed. The search for other matrix components has been directed towards hydrocarbons without tertiary carbon atoms. Different mixtures of n-pentane, n-hexane, cyclo-hexane, and neo-hexane give reasonably good glasses. In a mixture of neo-hexane and n-pentane the degree of recombination was found to be 30%. The path of reaction seems to be different for different disulfides, which indicates that intramolecular reactions and, possibly abstraction reactions occur between the radicals. A falling body method has been used for the determination of the temperature dependence of viscosity for a number of glasses aiming at the search for a correlation between viscosity and rate of recombination. The melting curves for these glasses have been recorded. The relation between the

S-S bond energy in different dialkyl disulfides is illustrated in a study of the disproportionation equilibrium $R_1S.SR_1 + R_2S.SR_2 \rightleftharpoons 2R_1S.SR_2$.

Lyman Lab. of Physics, Cambridge, Mass.
see Harvard U. Lyman Lab. of Physics, Cambridge, Mass.



1138

McMaster U. Hamilton Coll., Ont. (Canada).

SOME RECENT DETERMINATIONS OF ATOMIC MASSES IN THE STRONTIUM-ZIRCONIUM REGION, by N. R. Isenor, R. C. Barber, and H. E. Duckworth. Aug. 1, 1960 [5]p. incl. diagr. tables, refs. (AFOSR-TN-60-515) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)247 and National Research Council of Canada) AD 240110 Unclassified

Also published in Canad. Jour. Phys., v. 38: 819-823, June 1960.

A large double-focusing mass spectrometer has been used to obtain new values for the masses of Sr^{86}, Sr^{88}, and Zr^{90}. Mass differences calculated from these values are found to be in better agreement with nuclear transmutation information than were previous mass spectroscopically derived values. (Contractor's abstract)

1139

McMaster U. Hamilton Coll., Ont. (Canada).

FIRST MEASUREMENTS WITH THE McMASTER DOUBLE-FOCUSING MASS SPECTROMETER, by N. R. Isenor, R. C. Barber, and H. E. Duckworth. [1960] [6]p. incl. illus. tables. (AFOSR-776) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)247] and National Research Council of Canada) AD 258671 Unclassified

Also published in Proc. Internat'l. Conf. on Nuclidic Masses, McMaster U., Hamilton, Ont. (Canada) (Sept. 12-16, 1960), Toronto U. Press, 1960, p. 439-445.

More details are given in addition to a previous report (see item no. 1138, Vol. IV). The mass spectrometer consists of a 90° radial electrostatic analyzer followed by a semicircular magnetic analyzer. Both instruments are used symmetrically with the result that (1) the magnification is unity; and (2) the radii (~9 ft) of the ion paths in the 2 analyzers are equal. The ion source used is a 14-stage electron multiplier. A resolution of ~20,000 at the base of the peaks can be achieved. The method used in spacing of a mass spectral doublet, determined by a variation of the "peak-matching" technique, is explained. The results obtained are compared to previous ones and are found to agree well with the nuclear reaction data.

1140

McMaster U. Hamilton Coll., Ont. (Canada).

THE ELECTRIC QUADRUPOLE INTERACTION IN BETA DECAY, by J. M. Pearson and M. A. Preston. [1960] [19]p. incl. refs. [AF 49(638)247] Unclassified

Published in Nuclear Phys., v. 18: 91-109, Aug. 1960.

In the β-decay of strongly deformed nuclei the electrostatic field in which the decay electron moves by no means possesses the spherical symmetry that it has been customary to assume in β-decay theory. The angular momentum of the electron will not be conserved and different, closely lying, rotational states of the daughter nucleus will be coupled together. In this work we consider the possibility that it is this electric quadrupole coupling, rather than a failure of pure rotational structure, that is responsible for the observed anomalies in the branching ratios of the first forbidden decays of Lu^{176}, Ta^{180} and Np^{236}. The general theory of the β-decay of strongly deformed nuclei is set up, taking into account the electric quadrupole coupling, and specialized to the case of first forbidden decays of even nuclei. The electron functions are obtained by an essentially exact method, the Dirac equation appropriate to a non-control interaction being solved numerically on a computer. It is found that the coupling effect on the branching ratio can be no longer than 4% or so, which is far too small to account for the observed values. (Contractor's abstract)

1141

McMaster U. Hamilton Coll., Ont. (Canada).

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NUCLIDIC MASSES, McMaster U., Hamilton, Ont. (Canada), Sept. 12-16, 1960, ed. by H. E. Duckworth. Toronto U. Press, 1960, 539p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)247, Atomic Energy Commission, Canadian Association of Physicists, International Union of Pure and Applied Physics, National Academy of Sciences, National Research Council of Canada, Province of Ontario, and U. S. National Research Council) Unclassified

This conference was one of three international conferences held in Canada in conjunction with the meeting in Ottawa, Sept. 1960, of the General Assembly of the International Union of Pure and Applied Physics. The papers presented at the conference are given. The topics discussed include the statistical treatment of data for computation of atomic masses, correlation between masses and properties of nuclei, energy standards for calibration, nuclear reaction energies, beta decay energies, and mass spectroscopy. Abstracts are given for thirty of the papers.

1142

McMaster U. Hamilton Coll., Ont. (Canada).

OXIDATION OF METALS, by W. W. Smeltzer. [1960] [6]p. incl. tables, refs. (AFOSR-TN-60-420) [AF 49-(638)734] AD 237472 Unclassified

Published in Indus. and Eng. Chem., v. 52: 271-276, Mar. 1960.

The divergent viewpoints in this field are presented with 192 references categorized as reviews, theory, metal oxides, metal oxidation, and alloy oxidation.

1143

McMaster U. Hamilton Coll., Ont. (Canada).

OXIDATION OF METALS BY SHORT CIRCUIT AND LATTICE DIFFUSION OF OXYGEN, by W. W. Smeltzer, R. R. Haering, and J. S. Kirkaldy. [1960] [6]p. incl. diagrs. refs. [AFOSR-TN-60-981] (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)734] and the Defence Research Board of Canada) Unclassified

Published in Acta Metallurgica, v. 9: 880-885, Sept. 1961.

An expression has been derived for the initial oxidation rates of metals based upon the model of inward movement of oxygen through the lattice and along low resistance paths within the superficial oxide film. The equation involves 3 parameters: the parabolic rate constant, the ratio of the diffusion constants for short circuit and lattice diffusion, and the fraction of available oxygen sites lying within low resistance paths. The latter is assumed to decay in time as a first order rate process. It is demonstrated that this equation adequately represents the oxidation kinetics of Ti, Zr, and Hf in the temperature range of 300° - 600°C. The empirically determined activation energies for decay of low resistance sites lie between 7 and 12 kcal/mol. The ratios of the activation energies for short circuit and lattice diffusion in the dioxides of these metals are found to be in the range of 0.80 while the initial fraction of oxygen sites lying within defective material is estimated to be of the order of 0.1. This corresponds to a dislocation density of $10^{12}/cm^2$. (Contractor's abstract)

1144

Madrid U. Dept. of Crystallography (Spain).

ON THE X-RAY TEMPERATURE DIFFUSE SCATTERING OF ANTHRACENE AND STEARIC ACID, by S. Annaka and J. L. Amorós. [1960] [2]p. incl. diagrs. (AFOSR-4262) [AF 61(052)193] Unclassified

Published in Jour. Phys. Soc. Japan, v. 15: 356-357, Feb. 1960.

Also published in P. Dep. Crist. Min., v. 6 (1959-60).

Anthracene, $C_{14}H_{10}$, was studied qualitatively in the greater part of the reciprocal space by the systematic Laue method. Specially interesting areas were also studied quantitatively by a counter method. The diffuse scattering was composed of sharp streaks, thin planes and continuous regions. The strong diffuse scattering in some places where the structure factor is zero shows that the independent vibrations of the molecules must be taken into account besides the normal thermal waves. This is the direct consequence of the fact that $C_{14}H_{10}$ molecules are connected by weak van der Walls forces. Furthermore the analysis of Raman spectrum and crystal structure shows that the molecules are rotationally oscillating about the three orthogonal axes. Stearic acid, $CH_3(CH_2)_{16}COOH$, was also studied by the systematic Laue method. The intensity distribution of such diffuse scattering was also explained qualitatively by the independent harmonic vibration. (Contractor's abstract, modified)

1145

Madrid U. Dept. of Crystallography (Spain).

[THE EFFECT OF INDEPENDENT MOLECULAR VIBRATION ON DIFFUSE THERMAL DIFFRACTION] Efecto de las vibraciones moleculares independientes en la difracción difusa térmica, by M. L. Canut and J. L. Amorós. [1960] [16]p. incl. diagrs. refs. (AFOSR-4266) (AF 61(052)193) Unclassified

Published in Bol. R. Soc. Esp. Hist. Nat. (G.), v. 57: 43-58, 1960.

Also published in P. Dep. Crist. Min., v. 6 (1959-60).

The characteristics of the Fourier difference transformation are discussed. Graphs of the temperature factor vs $2\sin\theta$ for values of B of 1 - $10A^2$ for Cu and Mo radiation are given, with those for derived functions. The calculations show reasonable agreement with the experimental results. A discussion is made on the diffuse bands observed earlier by electron diffraction. It points out that the criticism made by Boersch and Catalina, and Catalina of the Charlesby, Finch and Wilman theory has no value. (Contractor's abstract, modified)

1146

Madrid U. Dept. of Crystallography (Spain).

ON THE X-RAY DIFFUSE SCATTERING OF ANTHRACENE, by S. Annaka and J. L. Amorós. [1960] [16]p. incl. diagrs. refs. (AFOSR-4267) [AF 61(052)193] Unclassified

Published in Zeitschr. Krist., v. 114: 423-438, Dec. 1960.

Also published in P. Dep. Crist. Min., v. 6, 1961.

The x-ray diffuse scattering from anthracene is studied by photographic and diffractometer techniques. The diffuse scattering is found to be composed of sharp

planes, streaks and weak continuous regions. The greater part of this continuous domains is explained quantitatively with the assumption of independent molecular harmonic vibration and libration. From this result, it is shown that the molecules of anthracene can vibrate quite independently in the crystal, specially in the direction of the L molecular axis and that the contribution of optical branch to the diffuse scattering of this molecular crystal is important. From the sharp plane of diffuse scattering from (409), an approximate dispersion curve is obtained for the transverse waves propagating perpendicular to the molecular plane. An atomic force constant $\beta = 1.6 \times 10^3$ dynes/cm is calculated from that dispersion curve and a simplified model of the structure. (Contractor's abstract, modified)

1147

Madrid U. Dept. of Crystallography (Spain).

ON THE INVERSION TEMPERATURE FUNCTION OF THE FIRST ORDER (ONE PHONON) SCATTERING AND THE DETERMINATION OF DEBYE CHARACTERISTIC TEMPERATURES, by M. L. Canut and J. L. Amorós. [1960] [9]p. incl. diagrs. tables, refs. (AFOSR-4273) [AF 61(052)193] Unclassified

Published in Proc. Phys. Soc. (London), v. 77: 712-720, Mar. 1961.

Starting from Laval's expression for the first-order thermal diffuse scattering (TDS_1), a new expression for the inversion temperature of TDS_1, $T_{max} = m\Theta_D^2 d_{hkl}^2 k/3h^2$, has been obtained, valid for a crystal of any symmetry, T_{max} is attained when $\overline{(u^2)}^{1/2}/d_{hkl} = 16\%$. Every crystalline substance has a definite range where the above formula holds: the upper limit is T_{mp} and the lower limit is Θ_D. The melting temperature defines a d_{max} for which the inversion phenomenon can be observable. The inversion curves of TDS_1 have been calculated for some metallic, ionic and molecular crystals. It is shown that KCl, Pb and Al, for which the inversion phenomenon has been reported, are not special cases. In molecular crystals this effect will be observable mainly at low temperatures. A method is given for determining Debye characteristic temperatures of crystals of any symmetry. This method is tested using Cartz's experimental T_{max} for Pb. (Contractor's abstract)

1148

Madrid U. Dept. of Crystallography (Spain).

INTERPRETATION OF THE EXTENDED CONTINUOUS DIFFUSE REGIONS OF X-RAY THERMAL DIFFUSE SCATTERING OF MOLECULAR CRYSTALS, by J. L. Amorós, M. L. Canut, and A. de Acha. [1960] [25]p. incl. diagrs. refs. [AF 61(052)193] Unclassified

Presented at meeting of the Amer. Cryst. Assoc., Cornell U., Ithaca, N. Y., July 19-24, 1959.

Published in Zeitschr. Krist., v. 114: 39-65, June 1960.

Also published in P. Dep. Crist. Min., v. 6 (1959-60).

In molecular crystals superimposed on the usual thermal diffuse spots and streaks, which can be explained in terms of the thermal wave theory, there also appear weak but continuous x-ray diffuse-scattering regions covering several reciprocal-lattice points, even forbidden ones. The shapes and locations of these diffuse domains are correlated with the shapes and orientations of the individual molecules. In hexamine, independent and almost spherical diffuse regions appear. Naphthalene shows anisotropic and independent domains in two different orientations. Dicarboxylic acids give diffuse sheets normal to the chain direction. Pentaerythritol presents continuous parallel diffuse bands normal to the layer plane. A new function, the difference Fourier transform (DFT) of the molecules has been obtained, and the experimental thermal diffuse scattering of adipic acid, succinic acid, hexamine and naphthalene is compared with the isodiffusion lines computed with the DFT. The agreement achieved shows that the DFT is a good approach to the interpretation of such continuous diffuse scattering regions in molecular crystals, where the diffuse scattering arises from independent molecular motion with vibrational frequencies of the optical type. This kind of diffuse scattering is proportional to $1 - \exp(-2B \sin^2\theta/\lambda^2)$, as the first prediction of Debye, and it has the same nature as the electron diffuse-scattering bands found in anthracene by Charlesby, Finch and Wilman. (Contractor's abstract)

1149

[Manitoba U. Dept. of Mathematics, Winnepeg (Canada)]

ON AN ALGORITHM OF G. BIRKHOFF CONCERNING DOUBLY STOCHASTIC MATRICES, by D. M. Johnson, A. L. Dulmage, and N. S. Mendelsohn. [1960] [6]p. (AFOSR-2797) (AF 49(638)860) Unclassified

Published in Canad. Math. Bull., v. 3: 237-242, Sept. 1960.

Graphs of non-negative matrices, irreducible graphs and canonical decomposition of a bipartite graph have been defined in earlier papers of Dulmage and Mendelsohn (Canad. Jour. Math., v. 10: 517-534, 1958; Trans. Roy. Soc. Canada, Sect. III, v. 53: 1-13, 1959). An n-square matrix with non-negative entries is doubly stochastic if all its row sums and column sums are equal to 1. G. Birkhoff (U. Nac. Tucumán. Rev. Ser. A, v. 5: 147-150, 1946) gave an algorithm for expressing a double stochastic matrix as an average of permutation matrices. In the present paper, graph-theoretical methods are used to show that the number of permutation matrices which may be used in Birkhoff's algorithm cannot exceed $N - 2n + k + 1$, where N is the number of non-zero entries in the matrix and k is the number of

disjoint irreducible subgraphs in the canonical decomposition of the bipartite graph of the matrix.

1150

[Marey Inst., Paris (France).]

[SOMESTHETIC RESPONSES COLLECTED AT THE LEVEL OF THE SUPRASYLVIAN ASSOCIATION CORTEX IN THE CURARIZED UNANESTHETIZED CAT] Réponses somesthésiques, visuilles et auditives, recuillies au niveau du cortex "associatif" suprasylvien chez le Chat curarisé non anesthesié, by P. Buser and P. Borenstein. [1958] [20]p. incl. illus. diagrs. tables, refs. [AF 61(052)103] Unclassified

Published in Electroencephalog. and Clin. Neurophysiol. Jour., v. 11: 285-304, May 1959.

The irradiating responses of 50 anesthetized cats to somato-sensory, visual, and auditory stimuli was studied. These responses were clearly distinguishable from the activities of the primary projection system by their latency and duration. The distribution of the responses was found to be generally quite extensive and localized to the surface of the association cortex. The association responses proved to be sensitive to depressing factors. Oscillations of the state of wakefulness determined significant variations of the associative irradiation. The secondary association responses seemed to occur independently from those of the primary projection areas. (Contractor's abstract)

1151

[Marey Inst., Paris (France).]

[RETICULAR SOMESTHETIC AND CORTICAL INFLUENCES AT THE LEVEL OF THE LATERAL ARTICULATED BODY IN THE CAT] Influences réticulaires somesthésiques et corticales au niveau du corps genouillé latéral du thalamus chez le Chat, by P. Buser and J. Segundo. [1959] [3]p. incl. illus. [AF 61(052)103] Unclassified

Published in Compt. Rend. Séances Acad. Sci., v. 249: 571-573, July 27, 1959.

The neurons of the visual thalamic relay (the lateral geniculated body, parsdorsalis) are studied for influences of another origin than the optic path, e.g., the reticulated formation, the somesthetic path or the cerebral cortex. Experiments on curarized and non-anesthetized animals are compared to those carried out under profound chloralose narcosis. The stimuli used are light flashes, electric shock to the paw, bipolar electrodes in the cortex and stereotaxically and concentrically oriented in the reticulated mesencephalic formation. Two modalities controlling the afferent visual message at the stage of the thalamic relay are of reticular and cortical origin. The reticular modality could regulate the cortical modality. The cortical activity can be related to the idea of an eventual centrifugal control of the cortex over the thalamus.

1152

[Marey Inst., Paris (France).]

THE ROLE OF NEURONAL NETWORKS IN SENSORY COMMUNICATIONS WITHIN THE BRAIN, by D. Albe-Fessard. [1959] [22]p. incl. illus. diagrs. refs. [AF 61(052)103] Unclassified

Published in Sensory Communication; Contributions to the Symposium on Principles of Sensory Communication, Endicott House, M.I.T. (July 19-Aug. 1, 1959) [Cambridge] M.I.T. Press, 1961, p. 585-606. (AFOSR-796)

The problem of how afferent messages from different origins can meet and interact within the brain is discussed with respect to various theoretical and experimental aspects. The principle of reverberation or regenerative feedback appears incapable of introducing order but diminishes the information content of sensory messages. It is concluded that the major principle of dynamic organization in intersensory as well as in simple sensory communications conjoins or opposes excitation and inhibition within networklike structures.

1153

[Marey Inst., Paris (France).]

[ROLE OF RELAYS FROM THE CENTRAL MEDIAL NUCLEUS OF THE THALAMUS FOR THE HETEROSENSORY CONNECTIONS OF THE CAUDAL NUCLEUS] Rôle de relais du nucleus centralis medialis du thalamus pour les afférences hétérosensorielles du noyau caudé by D. Albe-Fessard and J. Massion. [1959] [4]p. incl. illus. (AFOSR-TN-60-675) [AF 61(052)103] Unclassified

Published in Compt. Rend. Séances Soc. Biol., v. 153: 978-981, June 27, 1959.

Experiments are carried out on 10 cats anesthetized with chloralose (80 mg/kg intravenously) and immobilized with Flaxedil. The animal being fixed in a stereotaxic apparatus, is explored and stimulated by concentric electrodes with a diam of 0.5 and 0.7 mm. The nucleus centralis medialis receives afferent, somatic, auditory and visual projection. Stimulation induces a short latency response in the caudal nucleus, indicating that a monosynaptic connection exists between these 2 structures, which corresponds with the anatomical capabilities, the afferent influx can reach the central medial nucleus by the intermediary of the reticulated mesencephalic substance.

1154

[Marey Inst., Paris (France).]

[ACTIVITY OF SOMESTHETIC ORIGIN EVOKED AT THE LEVEL OF THE NON-SPECIFIC CORTEX AND AT NUCLEUS CENTER MEDIAN OF THE THALAMUS IN THE CHLORALOSE-ANESTHETIZED MONKEY] Activités d'origine somesthésique évoquées au niveau du cortex non-spécifique et du entre médian du thalamus chez le singe anesthésié au chloralose, by D. Albe-Fessard, C. Rocha-Miranda, and E. Oswaldo-Cruz. [1959] [11]p. incl. illus. diagrs. refs. (AFOSR-TN-60-676) (AF 61(052)103) AD 255032 Unclassified

Published in Electroencephalog. and Clin. Neurophysiol. Jour., v. 11: 777-787, Nov. 1959.

One same electrical stimulation of the teguments in monkeys anesthetized with chloralose gives rise on the non-buried cortex to responses in the postcentral, precentral, temporalis superior and frontalis superior gyri, and in the associative parietal areas. These well-individualized responses are separated by silent zones. The non-primary responses observed at the level of the frontal gyrus and in the associative parietal area had not yet been described. Only these have the property of being evoked by somatic stimulations from different origins. The regions involved are thus sites of convergence, these being part of the wider zones where intense spontaneous activities are observed. Responses endowed with converging properties can also be found in centrum medianum nucleus of the thalamus and in the zona incerta under the same conditions of peripheral stimulation. Stimulation of the centrum medianum n. evokes in the frontal gyrus responses of relatively long latencies; this makes it difficult to assume the existence of a direct connection between this nucleus and the frontal cortex, a connection that has never been recognized by histologists. The following points are discussed: possible mechanism of action of chloralose as revealing such activities as were described here, and role of centrum medianum nucleus as a relay along the secondary afferent pathways towards the frontal areas. (Contractor's abstract)

1155

[Marey Inst., Paris (France).]

[ON THE ORIGIN OF SLOW WAVES OBSERVED IN INTRACELLULAR DERIVATION IN DIVERSE CEREBRAL STRUCTURES] Sur l'origine des ondes lentes observées en dérivation intracellulaire dans diverses structures cérébrales, by D. Albe-Fessard. [1960] [6]p. incl. illus. refs. (AFOSR-TN-60-1310) [AF 61-(052)103] AD 623266 Unclassified

Also published in Compt. Rend. Séances Soc. Biol., v. 154: 11-16, Jan. 9, 1960.

The depolarization waves are formed by post synaptic excitation potentials. Their duration, sometimes rather long is explained by the repetitive character and the asynchronism of the afferent influx multiples. It is hard to specify a cellular body or a dendrite origin, however, if they are of great amplitude, probably the cellular body participates. Hyperpolarization waves could originate as a post reactionary membrane consecutive to the synaptic excitation potential. Or they could come from a post synaptic inhibition potential originating from terminals and particular paths.

1156

[Marey Inst., Paris (France).]

[NEUROPHYSIOLOGICAL GLOBAL OR UNITARY RESPONSES OBSERVED IN THE CENTRAL MEDIAN OF THE THALAMUS IN THE AWAKENED CAT] Réponses globales ou unitaires observées dans le centre médian du thalamus chez le Chat éveillé, by D. Albe-Fessard. [1960] [3]p. incl. illus. (AFOSR-TN-60-1311) [AF 61-(052)103] AD 623267 Unclassified

Also published in Neurophysiol., v. 10: 1-3, 1958.

Also published in Compt. Rend. Séances Acad. Sci., v. 250: 2616-2620, Apr. 4, 1960.

The responses comparable to that of the chloralosed animal are obtained from 12 cats immobilized by Flaxedil after anesthesia caused by ether. The responses in the optimal region obtained with the macroelectrodes are of notable amplitude but weaker than under chloralose (250 μV instead of 500 μV). The results obtained by microelectrodes show a permanent spontaneous activity in the thalamus. Heterotopic convergence properties exist in the responses in the central median of the awakened cat.

1157

[Marey Inst., Paris (France).]

[TRIGGERING REFLEX OF THE PYRAMIDAL SYSTEM IN THE CAT] Mise en jeu réflexe du systéme pyramidal chez le Chat, by P. Buser and Ph. Ascher. [1960] [22]p. incl. illus. diagrs. tables, refs. (AFOSR-TN-60-1312) (AF 61(052)103) AD 623266 Unclassified

Also published in Arch. Ital. Biol., v. 96: 123-164, 1960.

A study is made of the activity of the pyramidal bundle worked on by peripheral visual, acoustical and somesthetic stimuli as observed in 65 cats subjected to chloralose. Under anesthesia it is seen that a short stimulation of one of the sensorial modalities determines a reflex response of the pyramidal motor cortex upon the appearance of corticipetal sensorial influxes. The visual and acoustic pyramidal responses subsist. Although sometimes it is modified by excision of related areas or the temporo-parieto-occipital cortex ensemble,

the simultaneous or successive application of sensory stimuli of different modalities causes interactions between the corresponding responses.

1158

[Marey Inst., Paris (France).]

[SOME FEATURES OF THE ORGANIZATION OF THE AFFERENT PROJECTIONS IN THE MOTOR AREA OF THE CEREBRAL CORTEX OF THE CAT] Donnees sur l'organisation des projection afferentes au niveau du cortex moteur du Chat, by P. Buser and M. Imbert. [1959] [10]p. incl. illus. diagrs. refs. (AFOSR-TN-60-1313) (AF 61(052)103) AD 623269 Unclassified

Also published in Anales Facul. Med., v. 44: 220-229, 1959.

By cortical recording with extracellular microelectrodes, projections from different sensory modalities (visual, auditory, somatic) were identified in the motor (pericruciate) area of the cat and their organization studied. These experiments were performed on fifty animals, either under deep chloralosane narcosis, or unanesthetized (curarised preparations). It is shown that, on the pericruciate cortex, and in both experimental conditions, a dominant number of "polyvalent" units may be found, activated by any of the tested sensory systems. This pattern is in sharp contrast with the one found in the more caudally lying somatic area I. A transition zone, whose characteristics are complex, may also be identified. Some functional implications of our results (reflex activation of the pyramidal system by sensory stimulations, relationships between somatic I and motor area), are discussed. (Contractor's abstract)

1159

[Marey Inst., Paris (France).]

[ACTIVITIES EVOKED IN THE CAUDATE NUCLEUS OF THE CAT IN RESPONSE TO VARIOUS TYPES OF AFFERENT IMPULSES. I. MACROPHYSIOLOGICAL STUDY] Activités évoquées dans le noyau caudé du Chat en réponse a des types divers d'afférences. I. Étude macrophysiologique, by D. Albe-Fessard, E. Oswaldo-Cruz, and C. Rocha-Miranda. [1960] [16]p. incl. illus. diagr. tables, refs. (AFOSR-TN-60-1314) (AF 61(052)103) AD 614510 Unclassified

Also published in Electroencephalog. and Clin. Neurophysiol. Jour., v. 12: 405-420, May 1960.

Long-latency potentials of large amplitude are evoked in the region of the caudate nucleus by somatic, visual, auditory and olfactory stimulation either in anesthetized or nonanesthetized animals. Afferents are relayed through reticular formation, zona incerta, c. medianum, n. centralis medialis. The caudate responses were not spatially organized relative to the nature and locus of stimulation, they lacked a somatotopic arrangement. They were not modified by extensive ablation of cerebral and cerebellar cortex. Responses of short latency were elicited by motor cortex stimulation. (Contractor's abstract)

1160

[Marey Inst., Paris (France).]

[RESPONSES OBSERVED IN THE CENTRAL MEDIAN OF THE THALAMUS IN THE AWAKENED CAT, FREE, CARRIER OF FIXED ELECTRONS] Réponses observées dans le centre médian du thalamus chez le Chat éveillé, libre, porteur d'électrodes à demeure, by D. Albe-Fessard, J. Massion, and M. Meulders. [1960] [3]p. incl. illus. (AFOSR-TN-60-1363) [AF 61(062)103] AD 613736 Unclassified

Also published in Compt. Rend. Séances Acad. Sci., v. 250: 2928-2930, Apr. 25, 1960.

Four non-anesthetized cats were studied to see if the amplitude responses are due to the occlusion effect of the numerous afferent influxes. The response of the central median collected the moment of the operation caused by the inductor stimulation of the homolateral and contralateral anterior members is shown in graphs. The results are shown for cats awakened and under the influence of chloralose. Convergence properties are seen to be natural and fundamental properties.

1161

[Marey Inst., Paris (France).]

[DUALITY OF THE CENTRAL MEDIAN RESPONSES TO THE VISUAL STIMULATION] Dualité des réponses du centre médian à la stimulation visuelle, by D. Albe-Fessard and A. Mallart. [1960] [3]p. incl. illus. (AFOSR-TN-60-1384) [AF 61(052)103] AD 613727 Unclassified

Also published in Compt. Rend. Séances Acad. Sci., v. 251: 1191-1193, Sept. 12, 1960.

The skin of the cat, upon electrical or mechanical stimulation shows the existence of short and long latency responses in the central median of the thalamus. A study is made of the dual responses triggered by afferent stimulation of a visual origin. One technique used explores the central median with fine concentric bipolar electrodes (exterior diam 300 μ with insulated wire of 50 μ) and the other technique studies a single cell by means of glass microelectrodes (diam approximately 0.5 μ, with a resistance on the order of 15 MΩ). The interval between the first and second responses to visual stimulation is short and appears to be a direct result of the stimulus.

1162

[Marey Inst., Paris (France).]

[ACTIVITIES EVOKED IN THE CAUDATE NUCLEUS OF THE CAT IN RESPONSE TO VARIOUS TYPES OF AFFERENT IMPULSES. II. MICROPHYSIOLOGICAL STUDY] Activités évoquées dans le noyau caudé du Chat en réponse à des types divers d'afférences. II. Etude microphysiologique, by D. Albe-Fessard, C. Rocha-Miranda, and E. Oswaldo-Cruz. [1960] [13]p. incl. illus. tables, refs. (AFOSR-TN-60-1442) (AF 61-(052)103) AD 253776 Unclassified

Also published in Electroencephalog. and Clin. Neurophysiol Jour., v. 12: 649-661, Aug. 1960.

The activity of units in the caudate nucleus of the cat (whether recorded extra- or intracellulary) is different in the waking, non-anesthetized animal from that seen under chloralose anesthesia. In the former, the units display a continuous spontaneous activity, whereas in the latter, they are silent except when stimulation is applied. Furthermore, it is impossible to drive them in waking animals at frequencies higher than about one every 20 sec. Heterogeneous afferents have been shown to converge on one and the same neuron: somatic, visual and auditory as well as impulses from certain cortical areas, the reticular formation and the nucleus centrum medianum. The effects of varying the stimulus intensity upon latency, number and frequency of spikes and upon transmission delays have been studied. The study of the effects of the timing of non-firing depolarizing wave upon a test response (supra-liminal) has revealed the succession of one phase of facilitation (the summation of depolarization waves) and two phases of inhibition (the first of which is due to a subsequent hyperpolarizing process). It was shown that light pressure applied to the skin or to the deeper tissues (muscles excepted) is an adequate stimulus to evoke unit activity in the caudate. Group I fibers are not involved in these projections. (Contractor's abstract)

1163

[Marey Inst., Paris (France).]

[MICROPHYSIOLOGICAL STUDY OF THE SENSORY PROJECTIONS AT THE LEVEL OF THE POSTERIOR SUPRASYLVIAN CORTEX OF THE CAT] Étude microphysiologique des projections sensorielles au niveau du cortex suprasylvien postérieur chex le Chat, by M. Imbert. [1960] [2]p. (AFOSR-TN-60-1443) [AF 61-(052)103] AD 623270 Unclassified

Also published in Jour. Physiol. (Paris), v. 52: 126-127, May 1960.

The curarized, non-anesthetized and not subjected to chloralose cat is studied on a neuron scale. The organization at the level of the associative suprasylvian cortex of the sensory projections are revealed anteriorly by global exploration. The analysis of the posterior part of the suprasylvian gyrus is made of tactile, visual and acoustic stimuli, as well as stimulations of the reticulated formation by stereotaxically introduced bipolar electrodes. The visual responses are the most frequent and most precise. A threshold of dominantly somesthetic reactivity is localized more anteriorly. Characteristic acoustic responses rarely appeared. Similar results are obtained from specimens subjected to chloralose.

1164

[Marey Inst., Paris (France).]

[VISUAL AND ACOUSTIC RESPONSES AT THE LEVEL OF THE POSTERIOR VENTROMEDIAN COMPLEX OF THE THALAMUS IN THE CAT] Réponses visuelles et acoustiques au niveau du complexe ventromédian postérieur du thalamus chez le Chat, by P. Buser and J. Bruner. [1960] [3]p. incl. illus. diagrs. refs. (AFOSR-TN-60-1444) [AF 61(052)103] AD 623271 Unclassified

Also published in Compt. Rend. Séances Acad. Sci., v. 251: 1238-1240, Sept. 19, 1960.

The experiments are carried out under profound anesthesia with chloralose. The sub-cortical explorations are obtained by 5 concentric bipolar electrodes. The light and sound stimulations provide responses in the dorsal, lateral or ventral periphery. Thalamic responses to light and acoustic stimulation, simultaneously collected, are shown for the lateral posterior group and the median center. Visual responses are recorded and graphed for the limit of the posterior nuclear group, the suprasylvian ipsilateral associative cortex, the derivation from the ipsilateral motor cortex, the effect of a click of reduced intensity, the effect of a flash, and the effect of a combination of a click and a flash.

1165

[Marey Inst., Paris (France).]

[CORTICO-MESENCEPHALIC PATHWAYS STIMULATED BY SENSORY STIMULATIONS IN THE CAT] Mise en jeu des voies cortico-mésencéphaliques sous l'effet de stimulations sensorielles chez le Chat, by P. Buser and P. Borenstein. [1960] [1]p. (AFOSR-236) [AF 61(052)-103] AD 613735 Unclassified

Also published in Jour. Physiol. (Paris), v. 52: 40, 1960.

A simultaneous study on chloralose anesthetized and non-anesthetized curarized preparations provides 2 groups of data on the projection systems of the neocortex on the mesencephalic tegmentum. The topography of these projections is analyzed by local cortical stimulation and reticular derivation. The first study shows that all the points of the cortex are not equally rich in projections toward the reticulated mesencephalic

formation. The existence of a neocortical intervention, immediate and specific for the modality considered, is seen to work on the reticular reactivity on peripheral stimuli.

1165-A

[Marey Inst., Paris (France).]

[SOMESTHETIC PROJECTIONS ON THE MEDIAN ANTERIOR SURFACE OF THE CORTEX OF THE CAT ANESTHETIZED BY CHLORALOSE] Projections somesthésiques sur la face médiane antérieure du cortex chez le Chat, anesthesié au chloralose, by J. Bruner and P. Buser. [1960] [4]p. incl. diagrs. refs. (AFOSR-237) [AF 61(052)103] AD 613761 Unclassified

Also published in Compt. Rend. Séances Soc. Biol., v. 154: 530, 1960.

The deep areas of the median supra- and precallosal face of the hemispheres - the limbic cortex particularly- are studied for the determination of the sensory functions of the various projections. "Non-primary" thresholds of projection are investigated for localizability on the convexity at the level of either the associative areas or the motor cortex. The deeply anesthetized (8 to 10 cg/kg of i.v. chloralose) cat has the median face of the cortex exposed as much as possible for the study separating or eliminating the front part of the opposed hemisphere.

1166

[Marey Inst., Paris (France).]

[EXISTENCE OF A THRESHOLD OF ACOUSTIC SENSORY PROJECTION AT THE LEVEL OF THE ANSIFORM LOBE OF THE CEREBELLUM IN THE CAT] Existence d'un foyer de projection sensorielle acoustique au niveau du lobe ansiforme du cervelet chez le Chat, by P. Buser and H. Franchel. [1960] [3]p. incl. illus. (AFOSR-359) [AF 61(052)103] Unclassified

Published in Compt. Rend. Séances Acad. Sci., v. 251: 791-793, Aug. 1, 1960.

A complementary study of acoustic projections is made possible by another circumscribed threshold, situated more laterally in the posterior zone of the ansiform lobe. Short clicks operating at a slow cadence stimulate the anesthetized cat. The acoustic responses are considered at the level habitually considered as the vermian acoustic threshold. A second response threshold is studied on the posterior space of the ansiform lobe. Figures show the position of emplacement of the electrodes and the resulting recorded signal intensities.

1167

[Marey Inst., Paris (France).]

[VISUAL AND ACOUSTIC RESPONSES AT THE LEVEL OF THE MEDIAN ANTERIOR PLANE OF THE CORTEX IN THE CAT UNDER CHLORALOSE ANESTHESIA] Réponses visuelles et acoustiques au niveau de la face médiane antérieure du cortex chez le Chat sous chloralose, by J. Bruner. [1960] [1]p. (AFOSR-498) [AF 61(052)103] Unclassified

Presented at Association des Physiologistes de Langue francaise, Vingt-huitieme réunion, Brussels (Belgium), May 27-30, 1960.

Published in Jour. Physiol. (Paris), v. 52: 36, 1960.

A study is made of the thresholds of somesthetic, visual and acoustic sensory responses in the cat. With visual stimulation, one notices 2 areas of response: a dorsal area at the anterior edge of the splenial gyrus and the cingulum. With auditory stimulation, there are 2 areas of maximum activity: one is located at the edge of the cingulum and the first somesthetic surface; the other is located at the genual gyrus.

1168

[Marey Inst., Paris (France).]

SENSORY PROJECTIONS TO THE MOTOR CORTEX IN CATS: A MICROELECTRODE STUDY, by P. Buser and M. Imbert. [1959] [20]p. incl. illus. diagrs. tables, refs. (AFOSR-1328) (AF 61(052)103) Unclassified

Published in Sensory Communication: Contributions to the Symposium on Principles of Sensory Communication, Endicott House, M.I.T. (July 19-Aug. 1, 1959) [Cambridge] M.I.T. Press, 1961, p. 607-626. (AFOSR-796)

Sixty cats, either deeply anesthetized with chloralose or unanesthetized and immobilized with curare, were studied. The region explored involved the following gyri: anterior and posterior sigmoid, coronal, anterior suprasylvian, and anterior lateral. Two main sets of data were obtained under chloralose: (1) Several types of neurons can be distinguished in terms of their responsiveness to sensory stimuli. (2) Elements thus characterized are not scattered throughout the whole sensorimotor cortex but are rather precisely grouped in space according to their responsiveness. Essentially similar results were obtained under curare, the differences appeared in the relative number of units of polysensory and somatic responding indifferently to all four legs. These results confirm previous finding in macroelectrode studies on cats, that the "motor" cortex is a polysensory area, having projections simultaneously from visual, auditory, and somesthetic pathways. That these different sensory systems may activate the same

neuronal element is thus demonstrated by the present exploration on single units, which shows that facilitations or occlusions occur between responses from different origins.

1169

[Marey Inst., Paris (France).]

[OBSERVATIONS ON THE FUNCTIONAL ORGANIZATION OF THE MOTOR CORTEX OF THE CAT] Observations sur l'organisation fonctionnelle du cortex moteur chez le Chat, by P. Buser. [1960] [44]p. incl. illus. diagrs. refs. (AFOSR-3458) (AF 61(052)103) Unclassified

Also published in Bull. Acad. Suisse Sci. Med., v. 16: 355-397, 1960.

Microelectrode analysis indicates that a large portion of single units in the anterior sigmoid gyrus may be activated by light, sound, and somesthetic stimuli. A recording from the pyramidal tract at pontine level indicates that all 3 types of sensory messages may induce a reverberated corticifugal discharge from the motor cortex. Primary cortical projection fields are not necessary for the existence of sensory projections toward the motor cortex. However, their electrical stimulation may elicit pyramidal discharges and modification of their excitability may influence the level of pyramidal responsiveness to sensory stimuli. Results suggest that the pathway for visual and acoustic projection into the motor cortex provides through medial thalamic structures pertaining to the intralaminary system to nucleus centrum medianum parafascicularis. It is also suggested that the pathways corresponding to those modalities overlap at least partially at the thalamic level, thus making it probable that intermodality interactions may actually take place at these thalamic levels. (Contractor's abstract, modified)

1170

[Marey Inst., Paris (France).]

DISTRIBUTION OF RESPONSES TO SOMATIC AFFERENT STIMULI IN THE DIENCEPHALON OF THE CAT UNDER CHLORALOSE ANESTHESIA, by L. Kruger and D. Albe-Fessard. [1960] [26]p. incl. illus. table, refs (AFOSR-329) (AF 61(052)103) AD 253775 Unclassified

Published in Exper. Neurol., v. 2: 442-467, Oct. 1960.

Electrical responses to somatic afferent stimulation were studied with the aim of determining their distribution with respect to morphological groupings of the cat diencephalon in 212 histologically analyzed explorations. In addition to the well-known tactile projection to the ventrobasal (VB) complex, nontactile somatic responses of longer latency were found with reasonable consistency in the centrum medianum-parafascicular (CM) complex, posterior complex, central commissural system, ventrolateral complex, and nucleus ruber, as well as in several subthalamic structures for which the findings were somewhat less secure. Some evidence is presented suggesting that the CM response may be excited by the spinothalamic system and that responses in this region differ from those in the classical lemniscal pathway (VB) in modality and somatotopic representation, latency, spinal pathway, and anesthetic susceptibility. (Contractor's abstract)

1171

[Marseille U. (France).]

[RELATIONS BETWEEN THE ELECTROENCEPHALOGRAPHICAL VARIABLES AND THOSE EXPRESSING THE PERSONALITY AND THE SENSORY MOTOR FUNCTIONS. RESULTS OF AN INQUEST ACCOMPLISHED ON A HOMOGENOUS POPULATION OF YOUNG ADULT MALES, AGE 20 YEARS] Relations entre les variables électroencéphalographiques et celles exprimant la personnalité et les fonctions sensori-motrices. Résultats d'une enquete effectuée sur une population homogène de jeunes adultes males agés 20 ans, by H. Gastaut, F. Bacher and others. [1959] [71]p. incl. refs. (AFOSR-TN-60-1296) (AF 61(052)20) Unclassified

Also published in Rev. Neurol., v. 101: 320-390, May 1959.

The investigation undertakes the statistical treatment and verification of the electrical activity of the brain in relation with the psychological phenomena. Topics developed includes methods of statistical treatment, study of correlations between psychological variables, study of the correlations between the different E.E.G. variables, rapidity of visual perception, α-frequency and electroencephalographic data, electroencephalographic correlations in the motricity domain, aptitudes and personality and multivariate electroencephalographic patterns: a non-linear analysis and study of the correlations among the electroencephalographic and psychometric variables.

1172

Marseille U. (France).

FUNCTIONAL ORGANIZATION OF AFFERENT INNERVATION OF MUSCLE STUDIED IN MAN BY MONOSYNAPTIC TESTING, by J. Paillard. [1959] [9]p. incl. illus. diagr. (AFOSR-TN-60-1271) (AF 61(052)95) AD 246195 Unclassified

Presented at Symposium on The Innervation of Muscle, Utrecht (The Netherlands), July 1957.

Also published in Amer. Jour. Phys. Med., v. 38: 239-247, Dec. 1959.

The identification of a centrifugal control of the

neuromuscular spindles by the efferent gamma fibers has opened a new field of exploration of great theoretical and practical importance for our understanding of the function of muscle. To extend to man the recently acquired knowledge in this field from animal experimentation remains a rather difficult but important task for neurophysiology. A method of monosynaptic testing of the reactivity of the motoneurone in man was attempted under carefully defined experimental conditions, and some of the results obtained are reported. It is concluded that a more systematic application of these methods and a greater extension of this type of research in human neurophysiology should lead to a better understanding of the mode of functioning of the motor system in the intact individual. They could thus facilitate the necessary but always difficult reconciliation of experimental data from animal neurophysiology with the numerous clinical findings still badly understood in the pathology of the motor system.

1173

Marseille U. (France).

NEUROPHYSIOLOGICAL MECHANISMS OF SKILLED MOVEMENTS, by J. Paillard. Annual summary rept. May 1, 1959-Apr. 30, 1960. May 31, 1960, 6p. (AFOSR-TN-60-1490) (AF 61(052)95) AD 253849; PB 155532 Unclassified

The following investigations have been carried out: (1) Methodological problems: Correct techniques of investigating the monosynaptic test in man are now obtained. The problems of the restraining table, percussion apparatus, electronic stimulator have been satisfactorily solved. (2) Main research field: (a) By means of Hoffmann's reflex test, an attempt was made to analyze the nature of the generalized spread of activity which accompanies the performance of a voluntary act depending on its speed, intensity and duration. Even with a very simple movement, regardless of the muscle group involved, one can detect a brief facilitation of motoneurones of the triceps surae (with no overt muscle response) at the start of the movement and a long lasting inhibition at the end. (b) A systematic comparison between the reflex responses to electrical stimulation and the responses obtained by mechanical percussion of the tendon demonstrates identical electromyograms (both as regards form and duration of the muscular action potential). This method is used to discriminate the participation of the gamma innervation during voluntary activity. (3) Secondary problems pertaining to the contribution of proprioceptive afferents to the regulation of respiration; cases of hemiparkinson before and after coagulation of globus palidus; and familial periodic flaccid paralysis are also briefed. The research plan for the next period is outlined.

1174

Maryland U. [Dept. of Mathematics] College Park.

ON UNIQUENESS IN CAUCHY PROBLEMS FOR ELLIPTIC SYSTEMS OF EQUATIONS, by A. Douglis. Mar. 1960, 22p. incl. refs. (AFOSR-TN-60-249) (AF 49(638)590) AD 235377 Unclassified

Also published in Commun. Pure and Appl. Math., v. 13: 593-607, Nov. 1960.

The question has been raised as to whether the solutions of systems of linear, first order, partial differential equations in two independent variables, in the case of non-analytic coefficients, are uniquely determined by their Cauchy data. The answer to the question in the affirmative, when the characteristics are complex, sufficiently regular, and of multiplicities not greater than two. (Contractor's abstract)

1175

Maryland U. [Dept. of Mathematics] College Park.

AN ORDERING PRINCIPLE FOR CONSERVATION LAWS IN TWO VARIABLES, by A. Douglis. June 1960, 6p. (AFOSR-TN-60-570) (AF 49(638)590) AD 238073; PB 148361 Unclassified

If $F_{uu}(x,t,u) \geq 0$, the generalized solutions of the conservation law $u_t + (F(x,t,u))_x = 0$ are partially ordered like their initial data. (Contractor's abstract)

1176

Maryland U. [Dept. of Mathematics] College Park.

ON THE UNIQUENESS OF GENERALIZED SOLUTIONS OF FIRST ORDER, QUASILINEAR PARTIAL DIFFERENTIAL EQUATIONS, by A. Douglis. [1960] 7p. (AFOSR-TN-60-571) [AF 49(638)590] AD 238074; PB 148362 Unclassified

A simple proof is presented that the "generalized solutions" of partial differential equations of the form $u_t + (F(x,t,u))_x + G(x,t,u) = 0$ are uniquely determined by their Cauchy data. It is assumed that F, F_u, F_{ux}, F_{uu} are continuous for $t \geq 0$ and, for all values of x and u, that $F_{uu} \geq 0$, and that G is uniformly Lipschitz continuous in any definite region of x, t, u space with $t \geq 0$.

1177

Maryland U. [Dept. of Mathematics] College Park.

CONTINUOUS DEPENDENCE AND UNIQUENESS IN

CAUCHY'S PR[illegible]M FOR FIRST ORDER, NON-LINEAR, PA[illegible]L DIFFERENTIAL EQUATIONS, by A. Douglis. [illegible]0] 15p. (AFOSR-TN-60-572) [AF 49-(638)590] AD 238075; PB 148363 Unclassified

The C^n, n = 1, solutions of a non-linear, first order, sufficiently regular, partial differential equation of the form $(\partial U/\partial t) + [F(x, t, u, \partial u/\partial x)] = 0$ are known to depend continuously upon their initial data. Continuous dependence for solutions not of class C^n is considered.

1178

Maryland U. [Dept. of Mathematics] College Park.

ON A THEOREM OF CALDERON AND ZYGMUND ON THE FOURIER INVERSION IN E^n AND TWO FOURIER TRANSFORMS, by D. A. Sprecher. July 1960 [11]p. (AFOSR-TN-60-870) [AF 49(638)590] AD 242311; PB 150272 Unclassified

Two Fourier integrals, evaluated hitherto using the Fourier inversion theorem, are evaluated directly by elementary means. In the second part of the paper, a theorem of Calderón and Zygmund on the Fourier inversion in Euclidean space, E^n, is generalized and extended to Euclidean spaces of arbitrary dimensions. (Contractor's abstract)

1179

Maryland U. Dept. of Physics, College Park.-

ASTROPHYSICAL MEASUREMENTS FROM AN ARTIFICIAL EARTH SATELLITE, by S. F. Singer. [1953] [3]p. incl. diagrs. [AF 18(600)1038] Unclassified

Published in Rocket Exploration of the Upper Atmosphere; Proc. Conf., Oxford (Gt. Brit.) (Aug. 24-26, 1953), London, Pergamon Press, 1954, p. 368-370.

The possibilities are discussed of using an artificial earth satellite for the study of (1) solar ultraviolet and x-rays, (2) the primary cosmic radiation, and (3) solar corpuscular streams. (Contractor's abstract)

1180

Maryland U. Dept. of Physics, College Park.

INVESTIGATION OF THE SOLAR CORONA BY MEANS OF ROCKETS, by S. F. Singer. [1953] [4]p. incl. diagr. [AF 18(600)1038] Unclassified

Published in Rocket Exploration of the Upper Atmosphere; Proc. Conf., Oxford (Gt. Brit.) (Aug. 24-26, 1953), London, Pergamon Press, 1954, p. 371-374.

It is suggested that rockets be used for the investigation of the outer solar corona (predominantly the solar F-corona or dust corona). A rocket measurement has 2 principal advantages: (1) the background of scattered light from the atmosphere is substantially reduced, and (2) the region of wavelengths available for observations is vastly increased (from the infrared into the ultraviolet). These features, in particular, may make accessible for the first time the region at 5°-30° elongation from the sun which is of great importance in linking the solar corona with the zodiacal light. (Contractor's abstract)

1181

Maryland U. Dept. of Physics, College Park.

ROCKET EXPLORATION OF MAGNETIC FIELDS AND ELECTRIC CURRENTS IN THE UPPER ATMOSPHERE, by S. F. Singer. [1953] [5]p. incl. diagr. refs. [AF 18-(600)1038] Unclassified

Published in Rocket Exploration of the Upper Atmosphere; Proc. Conf., Oxford (Gt. Brit.) (Aug. 24-26, 1953), London, Pergamon Press, 1954, p. 256-260.

Tidal winds in the conducting layers of the earth's atmosphere produce emf's, and therefore a current system which is responsible for many of the geomagnetic variations observed at sea level. Rocket measurements at the magnetic equator have now established the existence of this current in the lower E-layer of the ionosphere. Because of the insufficient conductivity of even the whole atmosphere in the presence of a transverse magnetic field it has always been difficult to account for the current on the basis of a theory which does not require excessively high wind velocities. The experimental result shows that the current is distributed in only a very narrow layer, extending from 93-105 km. This finding forces a reconsideration of the theory of ionospheric conductivity. It leads to the suggestion that by means of a Hall polarization, which is set up perpendicular to the electric field and the earth's magnetic field, the conductivity at the equator is restored to the original high value which would exist in the absence of the magnetic field. In this way it is now possible to account for the ionospheric current system without invoking the presence of extremely high winds, i.e., velocities much greater than 100 km/hr. (Contractor's abstract)

1182

Maryland U. Dept. of Physics, College Park.

ELECTRON SPIN RESONANCE, by R. S. Anderson. Nov. 1960 [85]p. incl. diagrs. tables, refs. (Technical rept. no. 200) (AFOSR-TN-60-1373) (Bound with its AFOSR-217; AD 251449) (AF 18(600)1582) AD 246896 Unclassified

Also published in Methods of Experimental Phys., New York, Academic Press, v. 3: 441-500, 1962.

The relatively recent research technique of electron

spin resonance is reviewed with particular emphasis on experimental details, such as apparatus and interpretation. The theoretical section discusses those aspects of the method required both for the initiation and interpretation of experiments. The experimental section considers those details of importance to the design and operation of the apparatus. The following subjects have been treated: (1) quantum mechanical description, including energy levels, selection rules, effects of crystalline electrostatic fields and nuclear magnetic moments, and spin relaxation; (2) principles of spectrographs; (3) radio frequency and microwave components; (4) amplification and detection; (5) magnetic field; (6) sensitivity; and (7) electron-nuclear double resonance technique. (Contractor's abstract)

1183

Maryland U. Dept. of Physics, College Park.

RESEARCH IN ELECTRON RESONANCE SPECTROSCOPY. Final rept. Dec. 1960, 1v. incl. diagrs. tables, refs. (Technical rept. no. 207) (AFOSR-217) (AF 18-(600)1582) AD 251449 Unclassified

The properties of free atoms and free radicals have been investigated from Sept. 1955 to Sept. 1960. Research results during the first 2 yr gave the conclusion that the observation of rotational absorptions in the microwave region of unstable molecules or gaseous radicals was highly improbable since significant population of the unstable molecules was difficult to achieve even though optical spectrographic and chemical tests would indicate relatively large abundances. Hence the conditions for optical and chemical observations must be quite different from those required for the microwave absorption experiments. Experiments conducted during the following 3 yr concentrated on the use of ESR technique and obtained the following results: (1) unstable species or trapped radicals may be identified; (2) the relative strengths of the chemical bonds in a molecule are revealed; (3) the thermal conditions for radical stabilization are revealed; and (4) the spin density of electrons within a radical fragment are revealed. A list of publications, meeting presentations, and a number of the reprints produced under the contract are given.

1184

Maryland U. Dept. of Physics, College Park.

APPLICATIONS OF ELECTRON-SPIN RESONANCE (Abstract), by R. S. Anderson. [1960] [1]p. (Bound with its AFOSR-217; AD 251449) [AF 18(600)1582] Unclassified

Presented at Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 1960.

Following a brief review of the principles of ESR, consideration is given to applications of the method to physical, chemical, and biological systems. Various information may be derived from ESR observations. Examples are drawn from studies of crystalline parameters, nuclear spins and moments, color centers, polymerization processes, conduction processes, electron densities, and effects of radiation on matter. (Contractor's abstract)

1185

Maryland U. Dept. of Physics, College Park.

ELECTRON SPIN RESONANCE LINE SHAPES FOR SOLIDS HAVING NONISOTROPIC g-FACTORS, by R. P. Kohin and C. P. Poole, Jr. [1960] [12]p. incl. diagrs. (Bound with its AFOSR-217; AD 251449) (AF 18(600)-1582) Unclassified

For abstract see item no. MDU.04:003, Vol. II.

1186

Maryland U. Dept. of Physics, College Park.

ELECTRON SPIN RESONANCE SPECTRA OF ULTRAVIOLET IRRADIATED COMPOUNDS. II. NITROGEN TETROXIDE AND ORGANIC NITRO- COMPOUNDS, by J. Sohma, R. S. Anderson, and C. P. Poole, Jr. [1960] [14]p. incl. diagrs. table, refs. (Bound with its AFOSR-217; AD 251449) (AF 18(600)1582) Unclassified

Electron spin resonance examination of certain nitrogen-containing compounds, ultraviolet irradiated at 77°K reveals characteristic spectra. Polycrystalline nitrogen tetroxide, N_2O_4 is believed to form nitrogen dioxide, NO_2, upon irradiation. An identical spectrum was observed for irradiated ethyl nitrate, $C_2H_5ONO_2$, hence it is postulated that the NO_2 fragment remains stably trapped. Nitromethane, nitroethane and nitropropane spectra showed certain similarities as to the previous two compounds. However, the presence of additional hyperfine structure was interpreted to indicate that a C-H bond was broken. Although the ESR spectra indicated the typical polycrystalline cylindrical g-tensor symmetry, analysis of these spectra revealed the three principal g-values, 2.011, 2.007, and 1.998 ± 0.002 and the corresponding principal A-values, 60, 68, and 54 ± 5 gauss. (Contractor's abstract)

1187

Maryland U. Dept. of Physics, College Park.

ELECTRON SPIN RESONANCE SPECTRA OF ULTRAVIOLET IRRADIATED COMPOUNDS. III. ALDEHYDES AND KETONES, by C. P. Poole, Jr. and R. S. Anderson. [1960] [10]p. incl. diagrs. table. (Bound with its AFOSR-217; AD 251449) (AF 18(600)1582) Unclassified

The free radicals induced from ultraviolet irradiated

alkanals and alkanones are discussed. These compounds possess an ultraviolet absorption band corresponding to the excitation of a carbonyl group (C=O) electron from the ground level to an excited electronic level. An electronic rearrangement may occur following this excitation and leading to dissociation and the formation of free radicals. The bond dissociation energy of the carbonyl bond is about 150 kcal/mol which exceeds the available photon energy by 20%. The adjacent bonds are unusually weak (75 kcal/mol) so that one of these bonds will probably break following absorption of the proton. The experiments carried out are described. The results confirm that one of the 2 single bonds on the carbon atom of the carbonyl group is the most likely to break following the absorption of a photon. The number of free radials (N) was estimated to be 5×10^{14} DS_{Δ}^{B} spins/ml where D is the multiplicity factor, S the signal-to-noise ratio and ΔB the line width.

1188

Maryland U. Dept. of Physics, College Park.

LINE WIDTHS IN ELECTRON SPIN RESONANCE SPECTRA, by C. P. Poole, Jr. and R. S. Anderson. [1960] [9]p. incl. table. (Bound with its AFOSR-217; AD 251449) (AF 18(600)1582) Unclassified

The ESR line widths of radicals trapped in solids are calculated by assuming that the dipole-dipole interaction between the unpaired electron and nearby nuclei constitutes the principal line broadening mechanism. Calculated line widths are in good agreement with those experimentally observed. (Contractor's abstract)

1189

Maryland U. Dept. of Physics, College Park.

$|\Delta I| = \frac{1}{2}$ - RULE AND THE WEAK FOUR-FERMION INTERACTION, by S. Oneda, J. C. Pati, and B. Sakita. Dec. 1959 [10]p. incl. diagrs. table, refs. (Technical rept. no. 160) (AFOSR-TN-60-12) (In cooperation with Wisconsin U., Madison) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-24] and Atomic Energy Commission) AD 230873; PB 145511 Unclassified

Also published in Phys. Rev., v. 119: 482-484, July 1, 1960.

Although the usually considered diagram for the $\Lambda \to N + \pi$ decay arising from the interaction $(\bar{p}\,\Lambda)\,(\bar{n}p)$ can explain the decay rate, branching ratio, and asymmetry parameter of Λ decay, it fails to explain (a) the approximate validity of the $|\Delta I| = \frac{1}{2}$ rule, and (b) that the leptonic decay rates of the strange particles are slower than the universal rate, while the nonleptonic modes have nearly the universal rate. Introducing the effect of renormalization at the vertices of the strongly interacting particles phenomenologically, we have estimated the contributions to Λ decay from a set of diagrams satisfying the strict $|\Delta I| = \frac{1}{2}$ rule for both local and nonlocal Fermi interactions. It is found that they are considerably more important than the usual diagram. This makes it easier to explain the approximate $|\Delta I| = \frac{1}{2}$ rule. Moreover, since these diagrams do not contribute to leptonic modes, one can understand (b) by associating the strangeness-nonconserving current with a weaker coupling constant. These important classes of diagrams lead to different restrictions on the chiralities of the currents involved in Λ decay for local and nonlocal interactions. (Contractor's abstract)

1190

Maryland U. Dept. of Physics, College Park.

FINAL STATE INTERACTIONS AND $|\Delta I| = \frac{1}{2}$ RULE, by K. Chadan and S. Oneda. Mar. 1960, 5p. (Technical rept. no. 168) (AFOSR-TN-60-303) (AF 49(638)24) AD 235033; PB 149733 Unclassified

Also published in Phys. Rev., v. 119: 1126-1127, Aug. 1, 1960.

The effect of various isotopic spin selection rules and final-state interactions between two outgoing pions upon the K_{e4}/K_{e3} branching ratio are considered.

1191

Maryland U. Dept. of Physics, College Park.

ON THE DECAY INTERACTION OF STRANGE PARTICLES, by B. Sakita and S. Oneda. Feb. 1960, 14p. incl. diagrs. refs. (Technical rept. no. 165) (AFOSR-TN-60-304) (In cooperation with Wisconsin U., Madison) (AF 49(638)24) AD 234727; PB 147443 Unclassified

Also published in Nuclear Phys., v. 16: 72-80, Apr. 1960.

It is proposed that the strength of the coupling constants is different for the strangeness non-conserving and strangeness conserving currents in the scheme of Fermi interactions of an ordinary charged current-current type. First, the consistency with experimental results is analyzed by introducing phenomenologically the direct $\bar{\Lambda}$ n interaction which satisfies the $|\Delta I| = \frac{1}{2}$ rule in addition to the usually assumed primary Fermi interaction. Then, the possibility of the derivation of this interaction as the effective interaction of the primary Fermi interactions is discussed. (Contractor's abstract)

1192

Maryland U. Dept. of Physics, College Park.

DETERMINATION OF K^+-n P-WAVE PHASE SHIFTS FROM K^+-d REACTIONS, by T. B. Day, L. S. Rodberg

and others. Mar. 1960 [10]p. incl. diagrs. table. (Technical rept. no. 166) (AFOSR-TN-60-306) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)24 and Atomic Energy Commission under AT(40-1)2504) AD 234300; PB 146642 Unclassified

Also published in Nuovo Cimento, Series X, v. 16: 770-774, May 16, 1960.

Experiments are discussed which are to determine the P-wave phase shifts due to P-wave scattering in the K^+-neutron system from the charge exchange scattering data at energies of about 200 mev. This K^+-deuteron differential cross sections for the charge exchange and non-charge exchange (elastic plus break-up) processes are evaluated by impulse and closure approximations for an incident momentum of 520 mev/c (kinetic energy = 224 mev). The differential cross sections are studied for angles at which the K-nucleon interaction dominates over Coulomb and many-body effects.

1193

Maryland U. Dept. of Physics, College Park.

K^--DEUTERON SCATTERING AND THE K^--NUCLEON SCATTERING LENGTHS, by T. B. Day, C. A. Snow, and J. Sucher. Mar. 1960 [7]p. incl. table, refs. (Technical rept. no. 167) (AFOSR-TN-60-354) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)24 and Atomic Energy Commission under AT(40-1)2504) AD 234684; PB 149732 Unclassified

Also published in Phys. Rev., v. 119: 1100-1102, Aug. 1, 1960.

Cross sections for K^--d reactions have been calculated in the low-momentum region for several possible values of the elementary K^--nucleon scattering amplitudes. Multiple-scattering effects have been included in an approximate way. A comparison of the results for the sum of the elastic plus breakup cross sections with the preliminary measurements available is presented.

1194

Maryland U. Dept. of Physics, College Park.

ON THE LEPTONIC AND NON-LEPTONIC DECAY MODES OF K-MESONS, by J. C. Pati, S. Oneda, and B. Sakita. Apr. 1960 [36]p. incl. diagrs. table, refs. (Technical rept. no. 171) (AFOSR-TN-60-455) (In cooperation with Wisconsin U., Madison) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)24 and Atomic Energy Commission under AT(11-1)30) AD 236403 Unclassified

Also published in Nuclear Phys., v. 16: 316-337, Aug. 1960.

An attempt was made to explain the branching ratios of the various leptonic and nonleptonic modes of K-meson decays in the framework of V-A four-fermion interaction, extended to the tetrahedron scheme. The nonleptonic modes were investigated with the inclusion of a new class of diagrams for $\Lambda \rightarrow N + \pi$ - decays, satisfying the strict $|\Delta I| = \frac{1}{2}$ - rule. Final state pion-pion interactions are neglected. All the relative rates (involving ratios between different decay rates) can be explained reasonably well (at least as far as the order of magnitude is concerned) assuming that the matrix element for any process, evaluated by perturbation theory, should be damped by a factor $\approx \sqrt{3}$, whenever a pion is emitted from a closed baryon-antibaryon loop. The observed features of the approximate $|\Delta I| = \frac{1}{2}$ - rule in the nonleptonic modes of K-meson decays become clear by showing the marked importance of the new class of diagrams for $\Lambda \rightarrow N + \pi$-decays, which enter as virtual processes for K-meson decays. The fact that the final state in $K^+ \rightarrow \pi^+ + \pi^- + \pi^+$ -decay is predominantly symmetric between the 3 pions may be explained. (Contractor's abstract)

1195

Maryland U. Dept. of Physics, College Park.

ABSORPTION MECHANISMS OF NEGATIVE K MESONS AND PIONS IN LIQUID HYDROGEN, by T. B. Day. Apr. 1960 [18]p. incl. diagr. table, refs. (Technical rept. no. 175) (AFOSR-TN-60-501) (AF 49(638)24) AD 237128; PB 147740 Unclassified

An analysis was made of the experimental and theoretical studies on the slowing down and capture of negative mesons by the atoms and molecules in liquid hydrogen. The study indicates that even if one approaches the mesic atom problem from below, starting with the free meson-proton interaction, and working up through the ground state, one is forced into atomic problems of the higher excited levels in order to more clearly understand from which level one must assume the meson is captured. The conclusion is that the mesons are predominately captured from S states. This greatly increased the usefulness of the data on meson interactions at rest as far as interpretation in terms of more fundamental meson-proton interactions is concerned.

1196

Maryland U. Dept. of Physics, College Park.

CAPTURE OF K^--MESONS FROM HIGH S-ORBITALS IN HELIUM, by T. B. Day and G. A. Snow. June 1960, 7p. incl. refs. (Technical rept. no. 181) (AFOSR-TN-60-761) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)24 and Atomic Energy Commission) AD 239867; PB 149331 Unclassified

Also published in Phys. Rev. Ltrs., v. 5: 112-114, Aug. 1, 1960.

Some atomic and molecular processes which occur when K^--mesons stop and are captured in liquid helium are outlined quantitatively. It is shown that while the K^--meson is in its initially high-excited atomic state ($n \sim 20$-30), S-state capture is predominant. However, if the meson gets to lower states ($n \sim 10$), then P-state capture will be predominant.

1197

Maryland U. Dept. of Physics, College Park.

REGULARIZATION AND RENORMALIZATION T THROUGH FINITE-PART INTEGRALS, by E. R. Caianiello, A. Campolattaro, and B. Preziosi. June 1960 [33]p. incl. refs. (Technical rept. no. 182) (AFOSR-TN-60-762) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)24 and U. S. Army under DA-91-591-EUC-1096) AD 242655 Unclassified

The class of finite-part integrals is extended to cover all instances which may practically occur. Several possible prescriptions in configuration space which exhibit the wanted properties are discussed. Some prescriptions appear to be better suited to the study of general questions, such as renormalizability of a theory and deduction of the Lie equations of its renormalization group, while oth rs are more convenient for actual computation, once renormalizability is proved. (Contractor's abstract)

1198

Maryland U. Dept. of Physics, College Park.

ON THE ANALYTIC PROPERTIES OF THE 4-POINT FUNCTION IN PERTURBATION THEORY, by A. C.-T. Wu. July 1960 [145]p. incl. diagrs. refs. (Technical rept. no. 186) (AFOSR-TN-60-804) (AF 49(638)24) AD 240149; PB 149539 Unclassified

A discussion is presented of the explicit location of the singularities of the 4-point function in perturbation theory and their relevance criteria. The study also determines what constitutes the boundary of the domain. The main result is that D_4^{pert} is not bounded by analytic hypersurfaces. An analysis is made of the problem of the geometric envelopes for the 4-point singularity manifold. The 4-mass and 3-mass envelopes are shown to be trivial and cannot contribute to the boundary of the domain. Only the equations are given, but with the aid of a computer, all the boundary of the domain of the 4-point function can be explicitly plotted. The 1-mass curves (which are analytic) for some typical configurations in the space of 6 complex variables are illustrated to show the presence of the 2-mass envelopes.

1199

Maryland U. Dept. of Physics, College Park.

STRICT LOCALIZATION IN QUANTUM FIELD THEORY, by J. M. Knight and [J. S. Toll]. July 1960 [57]p. incl. diagrs. refs. (Technical rept. no. 187) (AFOSR-TN-60-818) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)24 and National Science Foundation) AD 240706; PB 149835 Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Feb. 1-4, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 58, Feb. 1, 1961.

A definition of strict localization of states in quantum field theory is presented. This definition is based on considering products of field operators as the primary measurable quantities of the theory. An example of a localized state is given, showing that such a state arises when a free field interacts with an external current that is limited to a bounded region of space-time. By means of a graphical technique, a state having a finite number of particles is shown not to satisfy the definition of localization. A simple representation of localized states is investigated, and arguments are given to support its generality and uniqueness.

1200

Maryland U. Dept. of Physics, College Park.

K^--MESON CAPTURE BY HELIUM, by T. B. Day. July 1960, 24p. incl. refs. (Technical rept. no. 183) (AFOSR-TN-60-819) (AF 49(638)24) AD 241466; PB 150106 Unclassified

Also published in Nuovo Cimento, Series X, v. 18: 381-394, Oct. 16, 1960.

Some atomic and molecular processes which occur when K^--mesons stop and are captured in liquid helium are investigated. It is shown that while the K^--meson is in its initially highly-excited atomic states, S-state capture is predominant. (Contractor's abstract)

1201

Maryland U. Dept. of Physics, College Park.

(Σ°, Λ°) RELATIVE PARITY AND THE DALITZ DECAY OF THE Σ° HYPERON, by J. Sucher and G. A. Snow. July 1960, 6p. (Technical rept. no. 188) (AFOSR-TN-60-853) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)24 and Atomic Energy Commission) AD 241467; PB 150110 Unclassified

Also published in Nuovo Cimento, Series X, v. 18: 195-197, Oct. 1, 1960.

The determination of the relative parity, P, of the Σ° and Λ° hyperon is of considerable interest. Feinberg (Phys. Rev., v. 109: 1019, 1958) showed that the branching ratio of the Dalitz decay, $\Sigma^\circ \rightarrow \Lambda^\circ + e^+ + e^-$, to the ordinary decay, $\Sigma^\circ \rightarrow \Lambda^\circ + \gamma$, depends on the value of P, being 1/184 for even (P = +1) and 1/165 for odd (P = -1) relative parity. It is the purpose of this analysis to point out that if a reaction can be found in which polarized Σ° hyperons are produced, then the angular correlation between the spin of the Λ° and the plane of the electron-positron pair in the Σ° Dalitz decay is very sensitive to the value of P.

1202

Maryland U. Dept. of Physics, College Park.

LIE EQUATIONS FOR A LEE MODEL, by E. R. Caianiello and S. Okubo. July 1960 [21]p. (Technical rept. no. 185) (AFOSR-TN-60-898) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)24 and U. S. Army under DA-91-91-591-EUC-1096) AD 242656 Unclassified

Also published in Nuovo Cimento, Series X, v. 19: 131-141, Jan. 1, 1961.

The renormalization in configuration space of a slight generalization of the Lee model is discussed. The replacement of ordinary with finite-part integrals removes consistently all ultraviolet infinities and permits one to write the Lie equations of the renormalization group, the solution of which yields the familiar relations between unrenormalized and renormalized parameters. (Contractor's abstract)

1203

Maryland U. Dept. of Physics, College Park.

RELATIVISTIC QUANTUM MECHANICS AND QUANTUM FIELD THEORY, VOLUME I, by J. Sucher. [1960] [222]p. incl. diagrs. table, refs. (Technical rept. no. 192) (AFOSR-TN-60-948) (AF 49(638)24) AD 243836 Unclassified

This is the first of three volumes. These notes are based on lectures given during a one-year course on Relativistic Quantum Mechanics (Physics 237) and Quantum Field Theory (Physics 258) at the University of Maryland. Elementary particle physics, relativistic wave equations and the quantization of fields are considered. Two-body reactions: partial waves and unitarity, are considered in the appendix.

1204

Maryland U. Dept. of Physics, College Park.

STRANGE PARTICLE DECAYS AND THE NATURE OF WEAK INTERACTIONS, VOLUME I, by J. C. Pati. Sept. 1960 [154]p. incl. diagrs. tables, refs. (Technical rept. no. 193) (AFOSR-TN-60-1051a) (AF 49(638)24) AD 244330; PB 152058-1 Unclassified

An attempt is made to provide a natural explanation of the approximate validity of the $|\Delta I| = \frac{1}{2}$ - rule as well as the slowness of the leptonic modes of strange particle-decays compared to the nonleptonic ones. The simplest scheme of weak interaction which introduces the primary weak interactions only among the leptons, the nucleons and the Λ-hyperon, is adopted. For $\Lambda \rightarrow N + \pi$ - decays a new set of diagrams, satisfying the strict $|\Delta I| = \frac{1}{2}$ - rule is much more important than the usually considered diagram, which contains appreciable amount of $|\Delta I| = 3/2$ transitions in addition to $|\Delta I| + \frac{1}{2}$ - ones. The relative rates of the various K^+ and $K^\circ_{1,2}$ - decay modes are estimated with the mechanism of Λ-decay developed both by perturbation theory and by approximate form-factor calculations. The inclusion of the new class of diagrams for $\Lambda \rightarrow N + \pi$ - decays leads to improved agreement with experiments for all the relative rates of K-meson decay modes. We assume phenomenologically a slight damping of the matrix element for each pion emission from a closed baryon-antibaryon loop. The possibility that the 4 fermion interactions may be mediated by a charged vector boson is examined. The immediate objection to such a possibility due to the slowness of $\mu \rightarrow e + \gamma$ - decay can be removed by assigning opposite lepton numbers to μ^- and e^- and adopting a restricted 4 component theory of the neutrino. The various possible effects of the nonlocality in the 4 fermion interactions are discussed. The effect of the intermediate boson on the $\Lambda \rightarrow N + \pi$ - decays is examined. The matrix element of the new class of diagrams is such that the observed sign of the asymmetry parameter of $\Lambda \rightarrow P + \pi^-$ - decay in the framework of V-A-interaction cannot be explained unless the intermediate boson is extremely heavy. (Contractor's abstract)

1205

Maryland U. Dept. of Physics, College Park.

STRANGE PARTICLE DECAYS AND THE NATURE OF WEAK INTERACTIONS, VOLUME II, by J. C. Pati. Sept. 1960 [143]p. incl. diagrs. tables, refs. (Technical rept. no. 193) (AFOSR-TN-60-1051b) (AF 49(638)24) AD 244331; PB 152058-2 Unclassified

The possibility that the 4 fermion interaction is mediated by a charged vector boson is examined. The immediate objection to such a possibility (due to slowness of the $\mu \rightarrow e + \gamma$ - decay) can be removed by assigning opposite lepton numbers to μ^- and e^- and adopting a restricted 4-component theory of the neutrino. The effects of the non-locality (though small, if the mass of the vector-boson is greater than that of K-meson) on the michel parameter and life-time of μ-decay are consistent with present experiments. The energy spectra of e, μ, and the pion in K_{e3} and $K_{\mu 3}$-decays are calculated for both local and non-local interactions with the

assumption that the form-factors are nearly constant over the range of variation in the pion-energy. An accurate measurement of the pion energy-spectrum in these decays could serve to distinguish between local and non-local interactions. The effect of non-locality is also investigated in $\Lambda \rightarrow N + \pi$-decays. (Contractor's abstract)

1206

Maryland U. Dept. of Physics, College Park.

A NEW REDUCTION TECHNIQUE IN QUANTUM FIELD THEORY, by J. S. Toll. Aug. 1960 [23]p. incl. diagrs. refs. (Technical rept. no. 194) (AFOSR-TN-60-1089) (AF 49(638)24) AD 243376 Unclassified

Also published in Proc. 1960 Annual Internat'l. Conf. on High Energy Physics, Rochester, N. Y. (Aug. 25- Sept. 1, 1960), New York, Interscience Publishers, 1960, p. 259-269.

A new technique is presented for reduction of the scattering matrix or other physical quantities in quantum field theory. These quantities are expressed as integrals involving vacuum expectation values of products of field variables. The procedure explicitly introduces functions which vanish outside the future light cone. The new technique has the advantage of yielding a larger primitive domain of analyticity and of not requiring local commutativity nor any other form of causality assumption beyond those requirements that are implicit in the modified asymptotic condition. The method is illustrated for the case of 2 particle scattering and for the vertex function, and checked in simple cases of examples in perturbation theory in lowest order. Without additional assumptions the reduction technique is shown to have only trivial consequences. Proofs are given that any matrix element can be chosen as an arbitrary invariant function of the energies and momentum transfers involved, and that it can still be extended off the mass shell to satisfy the analyticity and mass spectrum conditions.

1207

Maryland U. Dept. of Physics, College Park.

ANALYTICITY IN THE COUPLING CONSTANT AND BOUND STATES IN POTENTIAL THEORY, by B. Bosco and J. Sucher. Nov. 1960 [10]p. incl. diagrs. (Technical rept. no. 199) (AFOSR-TN-60-1434) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)24] and Atomic Energy Commission) AD 248970; PB 153872 Unclassified

Also published in Nuovo Cimento, Series X, v. 19: 1183-1188, Mar. 1961.

A method for determining the wave function in potential scattering, from the S-matrix, using unitarity and analyticity, is extended to the case where bound states are present by using analytic continuation in the coupling constant. A numerical example is given, illustrating the passage of a pole from the second Riemann sheet of the energy to the first sheet. (Contractor's abstract)

1208

Maryland U. Dept. of Physics, College Park.

CUSP PHENOMENA IN THE REGION OF TWO NEIGHBORING THRESHOLDS, by J. Sucher, G. A. Snow, and T. B. Day. Jan. 12, 1960 [14]p. incl. diagr. (Technical rept. no. 205) (AFOSR-174) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-24], Atomic Energy Commission, and National Science Foundation) AD 252054 Unclassified

Also published in Phys. Rev., v. 122: 1645-1648, June 1, 1961.

Previous discussions of the cusp phenomena at the threshold for a new reaction are extended to the case of two neighboring thresholds. The S-matrix is constructed from an n x n K-matrix in such a way as to insure that the physical S-matrix is unitary when only r of the n channels are open. As a special application, the amplitude for the reaction $\pi^- + p \rightarrow \Lambda^\circ + K^\circ$ is studied in the region of the Σ^- and Σ° thresholds. (Contractor's abstract)

1209

Maryland U. Dept. of Physics, College Park.

FORMULATION OF THE CAUSALITY REQUIREMENT, by J. G. Taylor and J. S. Toll. [1959] [6]p. incl. illus. [AF 49(638)24] Unclassified

Published in Nuovo Cimento, Series X, v. 15: 389-394, Feb. 1, 1960.

A formulation of the causality requirement is shown to differ in important respects from the usual requirement of no output before input. The formulation is more restrictive than the usual strict causality and excludes bound states and certain types of resonances that occur in theories of physical interest. The Klein-Gordon wave in terms of the characteristic momentum variable is analyzed and the way in which the formulation leads to a physically unacceptable extension of the domain of analyticity is described. (Contractor's abstract, modified)

1210

[Maryland U. Dept. of Physics, College Park.]

INTEGRAL REPRESENTATIONS FOR THE VACUUM EXPECTATION VALUE OF THREE SCALAR LOCAL FIELDS, by G. Källén and J. Toll. [1960] [20]p. incl. diagrs. [AF 49(638)24] Unclassified

Published in Helv. Phys. Acta, v. 33: 753-772, 1960.

The integral formula of S. Bergman and A. Weil for the representation of an analytic function of several complex variables is applied to the vacuum expectation value of 3 scalar local fields. Several versions of the result are given. The various formulae are connected with each other by integral transformations (Hankel transforms).

1211

Maryland U. Dept. of Physics, College Park.

THE ROTATION OF DIATOMIC MOLECULES IN MOLECULAR CRYSTALS, by B. C. Kohin. Jan. 1960, 77p. incl. diagrs. tables, refs. (Technical rept. no. 164) (AFOSR-TN-60-58) (AF 49(638)399) AD 233579; PB 146677 Unclassified

Also published in Jour. Chem. Phys., v. 33: 882-889, Sept. 1960. (Title varies)

Molecular rotation in crystals of N_2 and CO is investigated. The following contributions to the crystal field hindering free rotation are taken into account: (a) the interaction of the molecular quadrupoles; (b) the effect of the anisotropic molecular polarizabilities; (c) the asymmetry in the short-range repulsive forces. The results of a theoretical calculation of the minimum energy configuration support the structure proposed by Ruhemann (Zeitschr. Phys., v. 76: 368, 1932); it is shown that the crystal field is axially symmetric at each lattice site. A classical treatment of the rotational distribution leading to the prediction of a transition temperature for rotational order-disorder is carried out for non-polar diatomic molecules. The Schrödinger equation for a rigid rotor in the crystal field is solved for the lowest rotational states of CO and N_2. It is shown that the classical treatment is not justified for these crystals due to the large separations of the lowest eigenvalues. The zeropoint energy of rotation is found to be more than 1/2 as large as the zero-point vibrational energy. (Contractor's abstract)

1212

Maryland U. Dept. of Physics, College Park.

VIBRATIONAL THERMODYNAMIC PROPERTIES OF LATTICES WITH DEFECTS. II. TWO- AND THREE-DIMENSIONAL SIMPLE CUBIC LATTICES, by J. Mahanty, A. A. Maradudin, and G. H. Weiss. Mar. 1960, 19p. (Technical note no. BN-198) (AFOSR-TN-60-372) (AF 18(600)1315 and AF 49(638)399) AD 235773; PB 148993 Unclassified

Also published in Progr. Theoret. Phys., v. 24: 648-660, Sept. 1960.

A continuation and application of a previous work (MDU.02:022, Vol. II) is made dealing with 2- and 3-dimensional crystals. The methods are used to evaluate the changes in thermodynamic properties of a lattice due to the presence of defects of various kinds. The effects of an isotope defect and a pair of isotope defects on the zero point energy and free energy of 2- and 3-dimensional cubic lattices are considered. The free energy and self entropy of a vacancy in a 3-dimensional cubic lattice are evaluated. Appendices develop the leading term in the small f expansion of the Green's functions, a proof that the Green's functions have no singularities except on the real axis, and the defect determinant $|\Delta_1(0)|$

1213

Maryland U. Dept. of Physics, College Park.

FREQUENCY SPECTRA OF LATTICES WHOSE PARTICLES INTERACT WITH LONG RANGE FORCES, by J. A. Davies. Apr. 1960, 182p. incl. diagrs. table, refs. (Technical rept. no. 174) (AFOSR-TN-60-386) (AF 49(638)399) AD 237704; PB 149538 Unclassified

The properties of the normal mode frequency spectra of lattices in which long range interactions exist between the lattice particles are studied for 2- and 3-dimensional crystal models. The models are (1) two-dimensional square lattices with either transverse vibrations normal to the plane of the lattice, or with longitudinal vibrations in the plane of the lattice; and (2) a three-dimensional simple cubic lattice. The types of interactions assumed to exist between lattice particles are pair potentials varying as inverse powers of the distance between the interacting particles. Long range interactions are found to give rise to types of singularities in the frequency spectrum, and its derivatives, which do not occur when only short range interactions exist in the lattice. The nature of these singularities is studied, and several examples are given. A treatment of lattice models having only short range interactions between constituent particles is given for purposes of comparison with the long range potential models. (Contractor's abstract)

1214

Maryland U. Dept. of Physics, College Park.

THE ZERO-POINT ENERGY OF AN ELECTRON LATTICE, by A. A. Maradudin and R. A. Coldwell-Horsfall. May 1960, 34p. incl. refs. (Technical rept. no. 177) (AFOSR-TN-60-446) [AF 49(638)399] AD 606805; PB 147739 Unclassified

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 180, Mar. 21, 1960.

Also published in Jour. Math. Phys., v. 1: 395-404, Sept.-Oct. 1960.

At very low densities an electron gas in a compensating uniform background of positive charge crystallizes into a body-centered cubic lattice for which the correlation energy is known. At higher densities the 1st correction to this result arises from zero-point energy of the electrons. Kohn's sum rule leads to an upper bound of $E_o/N < 3/2(0.57735)\hbar\omega_p$ for the zero-point energy per electron, where ω_p is the classical plasma frequency. Alternatively, the zero-point energy can be expanded in terms of the even moments of the frequency spectrum. Since all terms in this expansion past the 1st 1 are negative, breaking off the expansion at any term gives an upper bound to the energy. With only the 1st 4 nonvanishing moments an upper bound of $E_o/N < 3/2(0.573)\hbar\omega_p$ is obtained. A better estimate can be obtained using the known asymptotic behavior of the higher moments which allows the complete expansion to be summed. This procedure leads to the estimate $E_o/N \approx 3/2(0.533)\hbar\omega_p$.

1215

Maryland U. Dept. of Physics, College Park.

DISTRIBUTION FUNCTIONS AND QUANTUM STATISTICS, by R. [U.] Ayres. May 1960, 48p. incl. refs. (Technical rept. no. 179) (AFOSR-TN-60-522) [AF 49-(638)399] AD 237448; PB 147937 Unclassified

Also published in Phys. Rev., v. 120: 1557-1571, Dec. 1, 1960.

A new formulation of quantum statistical mechanics is given, in terms of distribution functions. All quantities of interest are shown to be obtained directly from the distribution of particles in k-space, and the reaction operator K (often called the Brueckner K-matrix) which is familiar from stationary-state many-body perturbation theory. An integral equation for the distribution of particles in k-space is found, which can be solved by a converging iteration process. Some remarks are included on the application of the virial theorem to systems characterized by zero pressure. (Contractor's abstract)

1216

Maryland U. Dept. of Physics, College Park.

ON THE VIBRATION SPECTRUM OF A DISORDERED LINEAR LATTICE. I, by J. Mahanty. Oct. 1960, 8p. (Technical rept. no. 198) (AFOSR-TN-)-1124) (AF 49(638)399) AD 244592 Unclassified

Also published in Nuovo Cimento, Series X, v. 19: 46-52, Jan. 1, 1961.

The average eigenfrequency equation of a disordered 2-component linear chain is derived by a direct algebraic method. The moments of the frequency spectrum can be evaluated easily from this equation. (Contractor's abstract)

1217

Maryland U. [Dept. of Physics] College Park.

MOBILITY OF AN ELECTRON IN THE DONOR IMPURITY BAND OF A COMPENSATED SEMICONDUCTOR (Abstract), by A. A. Maradudin and B. S. Gourary. [1960] [1]p. [AF 49(638)399] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 264, Apr. 25, 1960.

The motion of an electron in an aperiodic 1-dimensional potential consisting of a random linear array of attractive delta-function potentials of equal strength is studied. It is shown that the ground state of this electron is nondegenerate, and that its energy is separated from that of the next higher energy state by a gap. These 2 results imply that mobility in such a system is an activated process. The relevance of the present model to impurity band conduction in nearly compensated semiconductors is discussed, and its relation to the recent work of N. F. Mott is described.

1218

Maryland U. [Dept. of Physics] College Park.

SINGLE-PARTICLE EXCITATIONS OF A DEGENERATE ELECTRON GAS, by A. J. Glick and R. A. Ferrell. [1959] [18]p. incl. diagrs. refs. (Sponsored jointly by [Air Force Office of Scientific Research under AF 49-(638)399], Atomic Energy Commission under AT(40-1)-2088, and Office of Naval Research under Nonr-179700) Unclassified

Published in Ann. Phys., v. 11: 359-376, Oct. 1960.

The continuum of single-electron excitations determines the properties of the degenerate electron gas and, hence, also many properties of metals. Lindhard's frequency and wave number dependent dielectric constant for the electron gas is rederived by considering only these excitations. Collective screening, and thus plasma effects, are then automatically taken into account by means of the Kramers-Kronig relations which the dielectric constant satisfies. Experiments on inelastic scattering by metal films have revealed the collective plasma excitation but have not given much information about the actual band structure and single-electron excitations in a metal. Study of the plasmon can at best only give some of the moments of the single-particle spectrum. Using the dielectric theory as a guide, an experiment

is here suggested to gain information about the continuum directly. The most favorable scattering angle for studying the single-particle excitations is found to be just beyond the plasmon cutoff. (Contractor's abstract)

1219

Maryland U. [Dept. of Physics] College Park.

CORRELATION EFFECTS ON THE ELECTRONIC SPECIFIC HEAT OF SODIUM, by E. A. Stern. [1960] [6]p. incl. diagrs. table, refs. [AF 49(638)399] Unclassified

Published in Phys. Rev., v. 121: 397-402, Jan. 15, 1961.

The effect of the martensitic transformation in sodium on measured values of its specific heat is analyzed. It is shown that the only important effect at low temperatures is to produce a mixture of the two phases. The measured specific heat is very closely given by the sum of the specific heats of each phase measured separately. An analysis of the various experimental measurements gives the result that the effective mass of conduction electrons in the bcc high-temperature phase is greater than 1.5 times the free electron mass while in the hcp low-temperature phase the corresponding value is less than 1.21. Using further experimental data it is estimated that the effective masses in the bcc high-temperature phase and hcp low-temperature phase are 1.7 and 1.1 times the free electron value, respectively. These effective mass values imply that there is substantial contact to the Fermi surface in the hcp structure with the "A" faces of the Brillouin zone. The large effective mass in the bcc phase indicates a large enhancement of the specific heat of the conduction electrons in sodium by correlation and electron-phonon interaction effects. The correlation effects alone appear to increase the specific heat of a free electron gas at a density corresponding to $r_s = 3.96$ (in units of the Bohr radius) by about 40%. (Contractor's abstract)

1220

Maryland U. [Dept. of Physics] College Park.

LIFETIME OF THE NEUTRAL PION, by V. Glaser and R. A. Ferrell. [1960] [7]p. incl. refs. [AF 49(638)399] Unclassified

Published in Phys. Rev., v. 121: 886-892, Feb. 1, 1961.

As Primakoff has noted, the phenomenological coupling constant of the neutral pion with the electromagnetic field can be investigated by considering the photoproduction of neutral pions in an external Coulomb field. This is the inverse of the usual 2-photon decay (1 of the photons being provided by the external field). The relationship between the cross section and the free lifetime of the π^0 is derived. Although the total cross section is small, it is found at high energy that the differential cross section is strongly peaked near the forward direction. The peak cross section is proportional to the fourth power of the photon energy. It is this feature which makes possible an experimental determination of the lifetime by the photoproduction method to an accuracy of about 10%. A minimum photon energy of 1 gev is required to avoid uncertainties in the nuclear form factor. A higher photon energy would be necessary only if the π^0 mean life is greater than 5×10^{-17} sec. The backgrounds to be expected from nuclear photoproduction are estimated and found to be sufficiently small. In particular, the interference between the coherent nuclear π^0 photoproduction and the Primakoff process is not excessive. (Contractor's abstract)

1221

Maryland U. Dept. of Physics, College Park.

ASPECTS OF THE MAGNETIC STORM BELT, by S. F. Singer and R. C. Wentworth. [1959] [12]p. incl. diagrs. [AF 49(638)530] Unclassified

Published in Proc. Symposium on Physical Processes in the Sun-Earth Environment, Ottawa (Canada) (July 20-21, 1959), DRTE Publication no. 1025, p. 335-346.

It was suggested in 1957 (see item no. MDU.03:023, Vol. I) that protons with energies of the order of 20 kev are injected into the earth's magnetic field about 1 day after a solar flare. Particles so trapped would drift perpendicular to the lines of force, and it was shown that a reasonable number of these protons, drifting at 4-8 earth radii, would constitute enough of a ring current to produce typical magnetic storms at the surface of the earth. The discover of the great belts of radiation permanently surrounding the earth lends support to the possible existence of such trapped protons. Some aspects of the theory of the motion of particles trapped in a magnetic dipole are now given. The 2 principal terms contributing to the drift of the particles, i.e., the magnetic gradient and the centrifugal force term, are considered. The current so produced is discussed. Magnetic storms last on the order of days, and it seems likely that charge exchange between the fast protons and the residual neutral hydrogen atmosphere will remove the protons in the right amount of time. Straightforward expressions for the drift velocity and current are found. It is concluded that not only is it likely that the magnetic storm protons drift to form a current, but that the permanent radiation belts will have their own magnetic effects, perhaps on a lesser scale.

1222

Maryland U. Dept. of Physics, College Park.

LIFETIMES OF GEOMAGNETICALLY TRAPPED PARTICLES DETERMINED BY COULOMB SCATTERING, by R. C. Wentworth. [1960] [107]p. incl. diagrs. tables, refs. (AFOSR-TN-60-288) (AF 49(638)533) AD 234186; PB 149650 Unclassified

Some aspects of the lifetimes to be expected for trapped fast particles, protons and electrons, in the earth's magnetic field are investigated. The scattering process was considered in detail for these particles as well as the energy loss mechanism. The lifetimes determined by these mechanisms range from minutes to many years depending on the particles scattered, their energies, and their distance from the earth. These calculations included only the scattering from the ionized component of the earth's outer atmosphere, although scattering from the neutral component can be added. The problem of pure energy loss with scattering neglected was easy to solve. The problem of pure scattering with no energy loss is more difficult. The conclusion drawn from the analysis of this problem is that the trapped particles random walk in their equatorial pitch angles as if they were always moving in a constant uniform density of scattering centers equal to one half of the equatorial density. Although the density of scattering centers is much greater near the trapped particles reflection point, the effect of scattering is much less than equatorial plane scattering. These 2 opposing effects roughly cancel.

1223

Maryland U. [Dept. of Physics] College Park.

THE LATITUDE AND ALTITUDE DISTRIBUTION OF GEOMAGNETICALLY TRAPPED PROTONS, by S. F. Singer. June 17, 1960 [8]p. incl. diagrs. refs. (AFOSR-TN-60-747) (AF 49(638)530) PB 149883
Unclassified

Also published in Phys. Rev. Ltrs., v. 5: 300-303, Oct. 1, 1960.

This is a continuation of an earlier work on the nature and properties of radiation-belt particles (see item no. MDU.03:042, Vol. II). A theory for the proton injection coefficient is derived and is used to calculate the latitude and altitude dependence of the trapped protons. After obtaining the differential directional intensity at all points in space, the necessary integrations are carried out by comparing the results from an omnidirectional detector having a lower energy limit of 20 mev to correspond to a simple thin-walled Geiger counter and 75 mev to correspond to a lead-shielded counter telescope. The contours of equal counting rate show a remarkable resemblance to contours which have been obtained experimentally for these cases.

1224

Maryland U. [Dept. of Physics] College Park.

ON THE NATURE AND ORIGIN OF THE EARTH'S RADIATION BELTS, by S. F. Singer. [1960] [24]p. incl. diagrs. refs. (AFOSR-TN-60-1397) (AF 49(638)530) AD 247371 Unclassified

Also published in Space Research: Proc. First Internat'l. Space Science Symposium, Nice (France) (Jan. 11-16, 1960), Amsterdam, North-Holland Publishing Co., 1960, p. 797-820.

A brief historical introduction traces the ideas which led to the prediction and eventual discovery of geomagnetically trapped radiation. It is concluded that the cosmic ray neutron albedo theory accounts well for the inner belt. The spatial distribution of high energy protons around the earth, including their dependence on altitude and latitude is derived. The extension of the theory gives the energy spectrum of these protons which is also in good accord with observations. The motion of the trapped particles produces magnetic effects. Here again the theory is well supported by direct observations carried out in the Lunik I rocket. The relation of geomagnetically trapped radiation to magnetic storms is discussed. (Contractor's abstract)

1225

Maryland U. Dept. of Physics, College Park.

AN OPTICAL ANALOG TO THE MOTION OF MAGNETICALLY TRAPPED PARTICLES, by D. Stern. [1960] [5]p. incl. diagrs. (AFOSR-25) [AF 49(638)530] AD 249719 Unclassified

Also published in Amer. Jour. Phys., v. 29: 767-771, Nov. 1961.

The motion of a beam of light confined in a diamond-shaped mirror geometry has properties in common with the motion of magnetically confined particles. A simplified model is constructed to illustrate that behavior depends on a certain numerical initial condition and fluctuates according to the terms of its continued fraction development. If this is infinite, the fluctuations will continue indefinitely, on a small though not intrinsically limited scale. However, if the numerical value is rational and its expansion finite, the fluctuations will exhibit a recurring pattern which may or may not be superimposed on a monotonous drift. (Contractor's abstract)

1226

Maryland U. [Dept. of Physics] College Park.

ENERGY SPECTRUM OF GEOMAGNETICALLY TRAPPED PROTONS (Abstract), by A. M. Lenchek and S. F. Singer. [1960] [1]p. [AF 49(638)530]
Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 47, Jan. 27, 1960.

The experimentally determined energy spectrum of hard protons in the inner radiation belt is in apparent

disagreement with the spectrum predicted from the neutron albedo theory. The real cause of disagreement appears to be the variation with altitude of the maximum energy which can be trapped by the geomagnetic field. The photographic emulsion in the experiment of Freden and White does not really measure the energy spectrum at 1200 km, but integrates contributions over a considerable altitude interval since the magnetic lines of force encountered by their rocket actually span an altitude range from 2500 to 4500 km in the plane of the magnetic equator. The analysis also leads to conclusions about the latitude and angular dependence of the trapped proton intensity.

1227

Maryland U. [Dept. of Physics] College Park.

LIFETIMES OF ARTIFICIALLY CREATED RADIATION BELTS (Abstract), by R. C. Wentworth and S. F. Singer. [1960] [1]p. [AF 49(638)530] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 47, Jan. 27, 1960.

The lifetime of trapped particles in the geomagnetic field depends on their nature and energy, on the location of the injection point, on the "noisiness" of the field, and other factors. In general particles are removed from the trapped condition when their magnetic moment is changed, either by charge exchange, by magnetic or atomic scattering, or by various energy losses. Here are considered only the effects of a tenuous atmosphere on the lifetime of relativistic (2-10 mev) electrons. After injection, a transient decay phase occurs during which the distribution approaches a quasi-steady-state. While the latter case has been discussed using a Fokker-Planck approach, the transient case can be adequately handled by considering diffusion of trapped particles on the surface of the momentum sphere. As a consequence of the transformation in pitch angle as a particle gyrates along a line of force, the lifetime is determined mainly by the atmospheric density in the equatorial plane and not by the density at the mirror points. This result is applied to the data of the Argus tests, and also to an experiment in which electrons are injected by an accelerator.

1228

Maryland U. [Dept. of Physics] College Park.

INTERPLANETARY GAS CLOUD MODULATION OF COSMIC RAYS (Abstract), by H. Laster, A. M. Lenchek, and S. F. Singer. [1960] [1]p. [AF 49(638)530] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 259, Apr. 25, 1960.

As suggested by Morrison, solar activity is assumed to be associated with the ejection of a cloud of magnetically turbulent gas. However, it is noted that in passing from the sun to the earth, this cloud expands significantly. Cosmic rays random-walk in the turbulent magnetic field of the cloud, making predominantly "overtaking" collisions with the magnetic inhomogeneities, which are receding from one another. This effect, together with the betatron deceleration in the weakening mean field, dominates over the statistical Fermi acceleration, and results in "diffusive deceleration" of the particles. Application of the extended Liouville theorem then shows that the intensity within the cloud is depressed; intensity as a function of position is obtained by an age-diffusion calculation. When the cloud envelops the earth, a Forbush decrease results. Its calculated dependence on time and on energy is in good agreement with observations.

1229

Maryland U. [Dept. of Physics] College Park.

WAKE OF A CHARGED BODY MOVING IN A PLASMA (Abstract), by E. H. Walker and S. F. Singer. [1960] [1]p. [AF 49(638)899] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 234, Apr. 25, 1960.

The earlier theory has been extended to the case where the magnetic field and velocity vector of the body are no longer parallel, and where the field in addition is nonhomogeneous. In this manner the case of a charged satellite moving in the earth's outer atmosphere is approached. As distinct from the case of parallel and homogeneous field, the charge cloud now detaches from the satellite but produces peculiar condensations of plasma which bear a fixed relation to the satellite, and may be termed "ghosts". Under nonsteady-state conditions this relationship changes and "ghosts" can travel with respect to the satellite. Some of the interesting properdies are discussed, particularly as they relate to radar observations. Detailed results on the distribution of charge around the satellite are presented. An important application of this work is to the question of the electric drag of an earth satellite.

1230

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

CONTINUATION OF SOLUTIONS OF THE EQUATIONS OF ELASTICITY, by J. H. Bramble. [1969] [19]p. incl. refs. (AF 18(600)573) Unclassified

Published in Proc. London Math. Soc., v. 10: 335-353, July 1960.

This paper deals with the equations of static equilibrium for an isotropic elastic body with a portion of the boundary spherical (circular). Continuations are obtained for the solutions of these equations where the displacements vanish on the spherical surface or circular arc in three and two dimensions respectively. The case where the normal stresses vanish on a circular arc (two dimensions) is also treated. This work may be considered as a sequel to a previous paper on continuation of biharmonic functions across circular arcs (MDU.09:069, Vol. II). (Contractor's abstract)

1231

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

RAYLEIGH'S PROBLEM AT LOW REYNOLDS NUMBER ACCORDING TO THE KINETIC THEORY OF GASES, by H.-T. Yang and L. Lees. [1958] [38]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)993 and Office of Ordnance Research under DA-04-495-Ord-19)
Unclassified

Also published in Rarefied Gas Dynamics; Proc. of First Internat'l. Symposium, Nice (France) (July 1958), New York, Pergamon Press, v. 3: 201-238, 1960.

Rayleigh's problem consists of the study of the fluid flow over an infinite flat plate set impulsively into uniform motion with velocity U in its own plane. The author conveniently divides the time history of Rayleigh's problem into 3 flow regions: (1) Low Reynolds's number on free molecule flow ($t/\tau < 1$), (2) High Reynold's number or gas flow dynamics ($t/\tau > 1$), and (3) Transitional regime ($t/\tau = 1$). The present study deals with the first case. The Maxwell-Boltzmann equation is employed in the study, although the collision integral in it is neglected. By integrating the various moments of the distribution function, all the flow properties such as pressure, density, temperature, velocity, stress, and energy flux are obtained as functions of time and space. These quantities evaluated at the plate surface correspond to the usual free-molecule values. After obtaining all the flow properties at low Reynold's number, 2 special cases are studied in detail: (1) the plate temperature equal to the ambient temperature, and (2) the heat-insulated plate.

1232

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

POINCARÉ CYCLES, ERGODICITY, AND IRREVERSIBILITY IN ASSEMBLIES OF COUPLED HARMONIC OSCILLATORS, by P. Mazur and E. [W.] Montroll. [1960] [15]p. incl. diagrs. table, refs. (AFOSR-TN-60-194) (In cooperation with Leyden U. (Netherlands)) (AF 18(600)1315 and [AF 61(052)16]) AD 245977
Unclassified

Also published in Jour. Math. Phys., v. 1: 70-84, Jan.-Feb. 1960.

The transport coefficients (diffusion, electrical conductivity, etc.) associated with irreversible processes in an assembly of particles can be expressed as integrals over certain time relaxed correlation functions between small numbers of variables of the assembly. The scattering of slow neutrons is also a measure of time relaxed correlation functions. Irreversiblity is a consequence of the vanishing of the correlation coefficients as the relaxation time becomes infinite. On the other hand these coefficients have Poincaré cycles so that any value which they take on is repeated an infinite number of times. It is shown that, in the case of fluctuations of $O(N^{-\frac{1}{2}})$ from zero (N being the number of degrees of freedom), the period of Poincaré cycles is of the order of the mean period of normal mode vibrations while for fluctuations of a magnitude independent of N the period is of the order of C^N where C is a constant greater than one. The time relaxed correlation coefficients of a pair of particles separated by r lattice spacings decays as $t^{-m/2}$, m being the number of dimensions of the assembly. The statistics of the decay of the momentum of a particle from a preassigned initial value to its equipartition value are discussed. (Contractor's abstract)

1233

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

MOBILITY OF AN ELECTRON IN THE DONOR IMPURITY BAND OF A COMPENSATED SEMICONDUCTOR, by A. A. Maradudin and B. S. Gourary. Feb. 1960 [20]p. incl. diagr. (Technical note no. BN-190) (AFOSR-TN-60-201) (In cooperation with Johns Hopkins U., Silver Spring, Md.) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1315 and [Office of Ordnance Research] under NOrd-7386) AD 234103; PB 147617
Unclassified

The motion of an electron is studied in an aperiodic one-dimensional potential consisting of a random linear array of attractive delta-function potentials of equal strength. It is shown that the ground state of this electron is nondegenerate, and that its energy is separated from that of the next higher energy state by a gap. These 2 results imply that mobility in such a system is an activated process. The relevance of the present model to impurity band conduction in nearly compensated semiconductors is pointed out, and its relation to the recent work of N. F. Mott (Canad. Jour. Phys., v. 34: 1356, 1956) is discussed. (Contractor's abstract)

1234

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

GREEN'S FUNCTIONS FOR MONATOMIC SIMPLE CUBIC LATTICES, by A. A. Maradudin, E. W. Montroll and others. Nov. 1959 [31]p. incl. diagr. tables, refs. (Technical note no. BN-188) (AFOSR-TN-60-202) (AF 18(600)1315 and AF 49(638)399) AD 234104; PB 146416 Unclassified

Also published in Mém. Acad. Roy. Belgique Cl. Sci., v. 14: 1-176, 1960.

A tabulation to six significant figures of the Green's functions for monatomic simple cubic lattices which are defined by the integral $I(a, b, c; \alpha; \beta) =$

$$\frac{1}{\pi^3}\int_0^{\pi}\int_0^{\pi}\int_0^{\pi}\frac{\cos ax \cos by \cos cz}{(2+\alpha)\beta - \cos x - \cos y - \alpha \cos z}\,dxdydz$$

is presented for the following ranges of the parameters:

$$\mu = \beta^{-1} = 0.00(0.01)1.00; \qquad \alpha = 1, 2, 4, 8, 16;$$
$$0 < a^2 + b^2 + c^2 < 15.$$

The recurrence formula satisfied by this integral, closed form expressions for the integral for special values of the parameters, asymptotic expressions valid in different ranges of the parameters, and examples of the applications of these tables are presented. (Contractor's abstract)

1235

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON VAN HOVE'S DIAGONAL SINGULARITY CONDITION, by J. Philippot. Mar. 1960 [11]p. incl. diagrs. (Technical note no. BN-199) (AFOSR-TN-60-344) (AF 18(600)1315) AD 235770; PB 148994 Unclassified

The property called by Van Hove "diagonal singularity" is shown not to be represented by a singularity of the δ type in the many body systems of interacting particles or phonons. The property, however, is verified in certain scattering problems, and is then a consequence of the random distribution of the scattering centers. (Contractor's abstract)

1236

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

APPLICATION OF SUMMABILITY METHODS TO SPECIFIC HEAT CALCULATIONS, by A. A. Maradudin, G. H. Weiss, and R. A. Sack. Mar. 1960 [13]p. incl. tables. (Technical note no. BN-201) (AFOSR-TN-60-345) (AF 18(600)1315) AD 235771; PB 148996 Unclassified

Thirring (Phys. Zeitschr., v. 14: 867, 1913; v. 15: 127-180, 1914) obtained an expansion for the vibrational contribution to the specific heat of a crystalline solid in powers of $1/T$. The coefficients of this Taylor series are proportional to successive moments of the frequency spectrum. Thirring's expansion converges only for $T > \Theta/2\pi$, where $\Theta = h\omega_L/k$ and ω_L is the max normal mode frequency. The series converges very poorly near the radius of convergence and is completely useless there. The series can be analytically continued beyond its radius of convergence by means of the Euler transformation, which, greatly increases the rate of convergence of the series near the radius, so that only about 7 moments are required for better than 3 figure accuracy for the specific heat of a body-centered cubic lattice at this point. Other methods for summing divergent series can also be used effectively. Some examples of the use of these methods are presented. (Contractor's abstract)

1237

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

IRREVERSIBILITY IN INTERACTING SPIN SYSTEMS, by J. Philippot. Mar. 1960, 14p. incl. diagrs. refs. (Technical note no. BN-200) (AFOSR-TN-60-346) (AF 18(600)1315) AD 235772; PB 148995 Unclassified

Also published in Phys. Rev., v. 119: 1803-1807, Sept. 15, 1960.

A system whose Hamiltonian is split into two terms $H = H_0 + \lambda V$ exhibits two types of irreversible processes. The first processes are described by the unperturbed Hamiltonian, H_0, only. The second processes, which result from the perturbation, lead to an increase of the entropy of the system. These processes are illustrated by the examples of free precession and cross relaxation. General formula are given for transition probabilities. The expressions applied to cross relaxation in LiF agree with the results obtained by Bloembergen and Pershan.

1238

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

QUANTUM STATISTICAL PAIR DISTRIBUTION FUNCTION. GENERAL THEORY AND ITS APPLICATION TO THE ELECTRON GAS, by S. Fujita. Mar. 1960, 84p. incl. diagrs. tables, refs. (Technical note no. BN-204) (AFOSR-TN-60-435) (AF 18(600)1315) AD 236455; PB 146929 Unclassified

A general theory for calculating the pair distribution function for a quantum statistical system is developed and applied to the electron gas. A cluster integral expansion for the pair distribution function of both quantum and classical systems is derived. Each cluster integral is represented by a hybrid (toron diagram) between a Mayer graph and a Feyman diagram in position-reciprocal temperature space. Analysis of diagrams leads to a theorem that the pair distribution function in grand canonical ensemble can be expressed in terms of two-body propagators. Various techniques, which were originally devised for the quantum field theory, are used for the analysis. In particular, the modified interaction is introduced as a partial sum of certain subdiagrams. It is shown that the simple chain approximation to the modified interaction is responsible for the transfer of a plasmon in the case of low temperature electron gas. The pair distribution function up to the first order in the modified interaction is calculated. A new expression which relates the internal energy with the pair distribution function is derived, assuming a system of many particles interacting through pair forces. This is used to calculate the ground-state energy of an electron gas. (Contractor's abstract)

1239

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

POINCARÉ CYCLES AND ERGODIC BEHAVIOUR OF A LINEAR DIATOMIC CHAIN, by L. S. Garcia-Colin. Apr. 1960 [24]p. (Technical note no. BN-206) (AFOSR-TN-60-466) (AF 18(600)1315) AD 236387; PB 147167 Unclassified

The ergodic behavior of a linear diatomic chain is shown to be analogous to that of a linear monoatomic chain. Expressions for the time relaxed correlation functions between any two particles in the chain are used to show that the existence of Poincaré cycles is not inconsistent with the development of an equilibrium state. Also, those dynamical variables which are ergodic for the linear monoatomic chain are shown to remain ergodic in the diatomic chain. The auto correlation functions for particles with equal or different masses are shown to decay in time as t^n, where $n = -1/2$. (Contractor's abstract)

1240

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON THE PAIR DISTRIBUTION FUNCTION OF A HARD SPHERE BOSE SYSTEM, by L. S. Garcia-Colin and J. Peretti. [1959] [10]p. incl. diagrs. refs. (AFOSR-TN-60-864) [AF 18(600)1315] AD 253070 Unclassified

Also published in Jour. Math. Phys., v. 1: 97-106, Mar.-Apr. 1960.

The pair distribution function for a quantum Bose gas is expressed as a power series in terms of the fugacity, the coefficients of which are temperature dependent. For the hard sphere case, these coefficients have been evaluated to the first order in a/λ, (a being the scattering length and λ the thermal wavelength) by using torons with two fixed points, or alternatively U cluster functions. The result gives the first order correction to the ideal gas formula of London and Placzek introduced by the interactions between the particles.

1241

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

THE CONTAINMENT OF PINCHED DISCHARGE BY AN AXIAL MAGNETIC FIELD. I, by R. K. Jaggi. Dec. 1960 [12]p. incl. illus. (Technical note no. BN-221) (AFOSR-47) (AF 18(600)1315) AD 249477 Unclassified

A calculation of the loss of deuterons from a pinched current to the wall of the container given by G. Thomson (Phil. Mag., v. 32: 886, 1958) is extended so that account is taken of an axial magnetic field. Such a field can materially reduce the particle loss. (Contractor's abstract)

1242

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

SOME PROBLEMS IN TRAFFIC DELAY, by G. H. Weiss and A. A. Maradudin. Dec. 1960 [57]p. incl. diagrs. refs. (Technical note no. BN-224) (AFOSR-125) (AF 18(600)1315) AD 250499 Unclassified

Also published in Operations Research, v. 10: 74-104, Feb. 1962.

Several variations of the problem of the delay time of a driver waiting at a stop sign for a gap in traffic large enough to either allow him to cross the road or merge with a lane of moving traffic are discussed. It is assumed that the headway distribution of the traffic on the main highway is known and that the waiting driver assigns a probability $\alpha(t)$ of crossing to a gap of length t. All the revelant statistics for the distribution of delay time are calculated using an integral equation formulation which allows complicated combinatorial arguments used for special cases to be bypassed. The concept of the transparency of a highway is introduced, i.e., the percentage of time that a waiting car will report a non-blocking gap on the highway. A general formula is given for this quantity in the limit of long times of observation. The problem of non-stationary headway distribution is formulated as a set of integral equations, which, however, have not been solved. The gap distribution for an N lane highway is given in terms of the individual gap distribution assuming that all lanes are treated on an

equal footing by the waiting driver. The case is discussed in which successive gaps in the moving lane of traffic are correlated in a simple manner. (Contractor's abstract)

1243

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

EFFECT OF IMPURITIES ON THE LOW-TEMPERATURE SPONTANEOUS MAGNETISM OF CUBIC FERROMAGNETIC CRYSTALS, by A. A. Maradudin and P. A. Dixon. [1960] [3]p. (AFOSR-3268) [AF 18(600)1315] Unclassified

Presented at Fifth Conf. on Magnetism and Magnetic Materials, Detroit, Mich., Nov. 16-19, 1959.

Also published in Jour. Appl. Phys., Suppl., v. 31: 329S-331S, May 1960.

This work concerns the development of mathematical techniques useful in the study of magnetic properties of lattices containing impurities. This method which is based on a theorem from the theory of contour integration and employs arguments from the theory of asymptotic expansions is applied to a derivation of the well known Bloch $T^{3/2}$ law for perfect lattices and to the case of a contaminated lattice. Results show that a stronger exchange coupling between a spin and its neighbor indicates that additional thermal energy must be supplied to the crystal to invert that spin, leading to a larger spontaneous magnetism.

1244

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

NONEQUILIBRIUM PROCESSES IN ISOTOPICALLY DISORDERED CRYSTALS, by A. [A.] Maradudin, G. H. Weiss, and D. W. Jepsen. [1960] [21]p. incl. refs. [AF 18(600)1315] Unclassified

Published in Jour. Math. Phys., v. 2: 349-369, May-June 1961.

The equations of motion of the atoms in an isotopically disordered crystal, which contains a fraction p of atoms of mass M_1, and a fraction 1-p of atoms of mass M_2, are expanded in terms of the normal coordinates of a monatomic lattice whose atoms all have mass $M = pM_1 + (1-p)M_2$. The equations of motion of these normal coordinates are derived and are then solved by Laplace transform methods. The perturbed normal coordinates are found to decay exponentially into the future and into the past until an inverse power dependence on time becomes dominant. Calculations of the mean lifetime and frequency shift of each normal coordinate are carried out for the 1-dimensional case. A theory of the optical absorption spectrum of an isotopically disordered ionic crystal is obtained, and the distribution function for the energies of the normal modes and the mean energy in a normal mode are found. The generalization of the methods of this paper to 3-dimensional lattices is discussed. (Contractor's abstract)

1245

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

AN OPTIMAL POINCARÉ INEQUALITY FOR CONVEX DOMAINS, by L. E. Payne and H. F. Weinberger. Feb. 1960, 13p. (Technical note no. BN-193) (AFOSR-TN-60-248) (AF 49(638)228) AD 233371; PB 146754 Unclassified

Also published in Arch. Rational Mech. Anal., v. 5: 286-292, 1960.

The second (first non-zero) eigenvalue μ_2 of the free membrane problem $\Delta v + \mu v = 0$ with $\partial v/\partial n = 0$ on the boundary for an n-dimensional convex domain of diameter D is shown to satisfy $\mu_2 \geq \pi^2 D^{-2}$. The eigenvalue μ is proportional to the square of the cutoff frequency of the lowest H-mode of a wave guide in 2-dimensions, to the lowest resonant frequency of acoustic resonator with perfectly rigid walls in 3-dimensions, and also, to the diffusion relaxation time in a body with perfectly reflecting boundary. μ_2 becomes equal to $\pi^2 D^{-2}$ for a thin parallelepiped.

1246

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

SOME ISOPERIMETRIC INEQUALITIES FOR MEMBRANE FREQUENCIES AND TORSIONAL RIGIDITY, L. E. Payne and H. F. Weinberger. Feb. 1960, 11p. incl. refs. (Technical note no. BN-194) (AFOSR-TN-60-292) (AF 49(638)228) AD 234089; PB 146422 Unclassified

Also published in Jour. Math. Anal. and Appl., v. 2: 210-216, Apr. 1961.

It is shown that among all membranes of given area fixed on an outer boundary of given perimeter and free along any inner holes the annular membrane has the highest fundamental frequency. A similar result is derived for membranes that are elastically supported on the outer boundary. The method leads to a lower bound for the torsional rigidity of a solid beam in terms of its area and perimeter.

1247

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

THE APPROXIMATION OF SOLUTIONS OF NON-LINEAR DIFFERENTIAL EQUATIONS, by M. D. George. Mar. 1960, 14p. (Technical note no. BN-196) (AFOSR-TN-60-329) (AF 49(638)228) AD 234729; PB 149730 Unclassified

The problem of approximating a semigroup of non-linear operators on a Banach space X, with particular reference to the problem of approximating solutions of initial-value problems for non-linear partial differential equations by means of finite difference schemes, is considered. Sufficient conditions are given for the convergency of a sequence of operators to a given semigroup of non-linear Banach space operators. It is shown that the equivalence of stability and convergence holds, provided that the definition of stability is modified slightly in a natural way. The stability of an approximation scheme will depend, for non-linear problems, not only on the approximating operators but also on the semigroup being approximated. Results are applied to a class of quasi-linear equations where the question of convergence can be handled rather easily by this method.

1248

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

A FABER-KRAHN INEQUALITY FOR WEDGE-LIKE MEMBRANES, by L. E. Payne and H. F. Weinberger. Mar. 1960, 15p. incl. refs. (Technical note no. BN-202) (AFOSR-TN-60-416) (AF 49(638)228) AD 235626; PB 148997 Unclassified

Also published in Jour. Math. and Phys., v. 39: 182-188, Oct. 1960.

Among all membranes lying in a wedge $0 \le \theta \le \pi/\alpha$, $\alpha \ge 1$ and having given value of $\iint r^{2\alpha} \sin^2 \alpha\theta \, r \, dr \, d\theta$, the circular sector of angle π/α is shown to have the lowest fundamental mode. This leads to lower bounds for the fundamental frequency of any membrane. (Contractor's abstract)

1249

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

A MAXIMUM PROPERTY OF CAUCHY'S PROBLEM IN THREE-DIMENSIONAL SPACE-TIME, by H. F. Weinberger. Apr. 1960 [15]p. incl. refs. (Technical note no. BN-205) (AFOSR-TN-60-464) (AF 49(638)228) AD 236592; PB 147309 Unclassified

Also published in Partial Differential Equations; Proc. Symposia in Pure Math., California U., Berkeley (Apr. 21-22, 1960), Providence, Amer. Math. Soc., v. 4: 91-99, 1961.

Cauchy's problem for the operator $Lu = \frac{\partial^2 u}{\partial t^2} - Mu$ where M is a two-dimensional elliptic Beltrami operator is considered. It is shown that if the Gaussian curvature corresponding to M is non-negative and satisfies a differential inequality and if Lu and the initial value of $\partial u/\partial t$ are non-positive, the maximum of u is attained on the initial plane t = 0. (Contractor's abstract)

1250

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

EXTENSIONS OF THE LAPLACE CASCADE METHOD, by J. H. Billings. Apr. 1960, 131p. incl. refs. (Technical note no. BN-209) (AFOSR-TN-60-503) (AF 49-(638)228) AD 236675; PB 147525 Unclassified

The Laplace cascade method for hyperbolic equations $u_{xy} + a(x,y)u_x b(x,y)u_y + c(x,y)u = 0$ is extended to systems of second order hyperbolic equations:

$$\frac{\partial^2 u_i}{\partial x \partial y} + \sum_{j=1}^{n} a_{ij} \frac{\partial u_j}{\partial x} + \sum_{j=1}^{n} b_{ij} \frac{\partial u_j}{\partial y} + \sum_{j=1}^{n} c_{ij} u_j = 0;$$

$i = 1, 2, \ldots, n$; to the linear hyperbolic equation $u_{xyz} + au_{yz} + bu_{xz} + cu_{xy} + du_x + eu_y + fu_z + gu = 0$; and to the corresponding hyperbolic equation in n independent variables. After expression of the system in matrix form, the cascade method is used to develop chains and solutions. In the concluding section, the extensions made by Darboux, Dini, and Le Roux to systems of second-order equations in one dependent variable, to a single second order equation in n independent variables, and to a single n^{th} order equation in two independent variables are discussed.

1251

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

AN ITERATIVE SOLUTION OF LARGE SCALE SYSTEMS OF SIMULTANEOUS LINEAR EQUATIONS, by F. J. Bellar, Jr. May 1960, 9p. incl. table. (Technical note no. BN-211) (AFOSR-TN-60-550) (AF 49(638)228) AD 237435 Unclassified

Also published in Jour. Soc. Indus. and Appl. Math., v. 9: 189-193, June 1961.

An algorithm proposed by Lanczos (Jour. Soc. Indus. and Appl. Math., v. 6: 91-109, 1958) for the generation of an approximate solution of a large scale system of simultaneous linear equations is improved so that the

number of iterations required for a desired degree of accuracy is minimized. A solution vector $\vec{y}$ of the system $A\vec{y} = \vec{b}$ is obtained where A is an n x n Hermitian positive definite matrix and $\vec{b}$ is a given n-dimensional vector. The well known solution $\vec{y}$ is given as $\vec{y} = \sum_1^n \frac{B_i}{\lambda_i} \vec{u}_i$ and if $P_m(x)$ is any polynomial which approximates x^{-1}, then by substitution it becomes necessary to approximate x^{-1} with a polynomial. The relative error introduced in approximating $1/x$ by $P_m(x)$ is at most d_m which is calculated. The approximation to the solution $\vec{y}$ is notated as Y_m, and because the positive lower bound is greater than 0 but lesser than or equal to λ_1 the smallest eigenvalue of A, a relative error bound is present given as $\|\vec{Y}_m - \vec{y}\| \leq d_m \|\vec{y}\|$. A solution to $A\vec{y} = \vec{b}$ where A is arbitrary is then obtained based on the approximate solution vector for $\vec{y}$. For the algorithm of this paper d_M is allowed to be 0.05 which by computing for M gives the number of iterations required for 5% accuracy. By comparing these figures with those of Lanczos it is evident that the method presented here significantly reduces the number of computations required for a certain degree of accuracy.

1252

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

BOUNDS FOR EIGENVALUES AND THE METHOD OF INTERMEDIATE PROBLEMS, by A. Weinstein. July 1960, 24p. incl. refs. (Technical note no. BN-212) (AFOSR-TN-60-722) (AF 49(638)228) AD 239532; PB 149100 Unclassified

Also published in Partial Differential Equations and Continuum Mechanics; Proc. Internat'l. Conf., Wisconsin U., Madison (June 7-15, 1960), Madison, Wisconsin U. Press, 1961, p. 39-53.

An analysis is presented of the developments in the theory of eigenvalues. The problem of obtaining lower bounds is discussed for the eigenvalues of sufficiently regular differential operators. Recent progress made in the procedure called the method of intermediate problems is discussed. Only formal aspects of the method are studied. Operators, such as partial differential operators, which admit a discrete point spectrum bounded below are considered. The method also applied to the lowest part of the spectrum of operators which consists of a denumerable sequence of eigenvalues with finite multiplicity which converges to a finite limit. The operators are self-adjoint or at least symmetric in their domain of definition.

1253

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON SOME NEW CONTINUATION FORMULAS AND UNIQUENESS THEOREMS IN THE THEORY OF ELASTICITY, by H. H. Bramble and L. E. Payne. July 1960, 28p. (Technical note no. BN-213) (AFOSR-TN-60-723) (AF 49(638)228) AD 239533; PB 149101 Unclassified

Also published in Jour. Math. Anal. and Appl., v. 3: 1-17, Aug. 1961.

New continuation formulae for the solution of the equations of classical elasticity are derived. It is shown that it is possible to obtain an explicit formula for the continuation of the displacement vector across a spherical portion Q of the boundary of a general region D in two cases: (1) When the normal component of surface traction, the normal component of the displacement vector and the normal component of the rotational vector vanish on Q, and (2) When the tangential components of the surface tractions and the tangential components of the displacement vector vanish on Q. In considering the question of uniqueness of solution of boundary value problems, two types of circumstances are prescribed pertaining to the displacement vector satisfying the equations of elasticity on the interior (exterior) of a sphere. It is shown that if the displacement vector satisfies the equations in the region exterior to the sphere and suitable conditions are imposed, the boundary value problem has at most one solution for the physically interesting values of the Lame constants when the normal displacement and the normal component of the surface traction are prescribed. If the region of definition is the interior of the sphere the boundary value problem does not have a unique solution. When the surface tractions and tangential components of displacement are prescribed, there is again at most one solution if suitable conditions are imposed at infinity. However, if the solution is normalized in such a way as to fix the arbitrary hydrostatic pressure, there are still an infinite number of values of σ for which the solution is not unique. It is also pointed out that for the boundary value problem in which the tangential components of surface traction and tangential displacements are prescribed over the entire spherical surface the solution will in general not exist.

1254

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON THE CONTINUATION OF SOLUTIONS OF THE EQUATIONS OF ELASTICITY BY REFLECTION, by J. H. Bramble and L. E. Payne. Aug. 1960 [8]p. (Technical note no. BN-217) (AFOSR-TN-60-903) (AF 49(638)-228) AD 241211; PB 150037 Unclassified

Also published in Duke Math. Jour., v. 28: 247-252, June 1961.

It is shown that solutions of the equations of elasticity may be continued by reflection across a spherical boundary whenever an arbitrary linear combination of the normal displacement and normal surface traction and an arbitrary linear combination of tangential displacements and tangential surface tractions vanish on the spherical surface. (Contractor's abstract)

1255

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON EXISTENCE, UNIQUENESS, AND NUMERICAL EVALUATION OF SOLUTIONS OF ORDINARY AND HYPERBOLIC DIFFERENTIAL EQUATIONS, by J. B. Diaz. Sept. 1960, 29p. incl. refs. (Technical note no. BN-216) (AFOSR-TN-60-1059) (AF 49(638)228) AD 242860 Unclassified

Presented at Sixth Conf. of Arsenal Mathematicians, Duke U., Durham, N. C., June 1-2, 1960.

Also published in Proc. of Symposium on the Numerical Treatment of Ordinary Differential Equations, Integral and Integro-differential Equations, Rome (Italy) (Sept. 20-24, 1960), Basel, Birkhauser, 1960, p. 581-602.

The proof of the general uniqueness theorem for the hyperbolic partial differential equation $u_{xy} = f(x, y, u)$ is shown to be an exact analogue of the proof of the general uniqueness theorem for the ordinary differential equation $\frac{dy}{dx} = f(x,y)$. (Contractor's abstract)

1256

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

A NEW DECOMPOSITION FORMULA IN THE THEORY OF ELASTICITY, by J. H. Bramble and L. E. Payne. Sept. 1960, 13p. (Technical note no. BN-218) (AFOSR-TN-60-1129) (AF 49(638)228) AD 244833; PB 152609 Unclassified

Convenient representations for the spherical components of displacement in terms of harmonic functions are obtained which simplify mixed boundary value problems for the sphere. By reducing the elasticity problem to one in potential theory, where all terms of the representation are harmonic, it is possible to obtain in a straight forward way, sphere theorems with various combinations of surface tractions and displacements vanishing on the surface of the sphere. If in the harmonic representations the constant α, which is restricted only in that it be different for -1, is allowed to tend to infinity while at the same time αG, a soluable unknown, tends to a harmonic function F, then these decompositions may be interpreted as representation formulae for the spherical components of the velocity vector in the slow motion of viscous fluids.

1257

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

NEW MEAN VALUE THEOREMS IN ELASTICITY, by J. B. Diaz and L. E. Payne. Nov. 1960, 14p. incl. refs. (Technical note no. BN-210) (AFOSR-5) (AF 49(638)228) AD 249358; PB 154143 Unclassified

Also published in Contrib. Differential Equations, v. 1: 29-38, 1963. (Title varies)

Three mean value theorems in the theory of elasticity are derived. The first two express the stress components at the center of a sphere in terms of (1) the normal surface displacement and the tangential surface tractions, and (2) the tangential surface displacement and the normal component of the surface traction. The third mean value theorem expresses the components of the stress deviator tensor in terms of the tangential displacements and the tangential surface tractions. (Contractor's abstract)

1258

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

AN ANALOGUE OF THE SPHERICAL HARMONICS FOR THE EQUATIONS OF ELASTICITY, by J. H. Bramble and L. E. Payne. Nov. 1960, 16p. (Technical note no. BN-222) (AFOSR-6) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-228 and Naval Ordnance Laboratory) AD 249359; PB 154144 Unclassified

Also published in Jour. Math. and Phys., v. 40: 163-171, July 1961.

For the interior of an elastic sphere, a set of solutions is obtained of the displacement equations of classical elasticity which form a complete orthogonal system of vectors on the surface of the sphere. These functions should prove useful in approximating solutions of boundary value problems in elasticity.

1259

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

A NOTE ON INEQUALITIES FOR PLATE EIGENVALUES, by L. E. Payne. [1960] [5]p. (AF 49(638)228) Unclassified

Published in Jour. Math. and Phys., v. 39: 155-159, July 1960.

Let λ_1, A_1, and Ω_1 be the lowest eigenvalues respectively of the fixed membrane problem, the clamped plate

plate vibration problem on a domain D. It is shown that if D is convex, $\Lambda_1 \leq 4\lambda_1$, $\Omega_1 < \frac{16}{3}\lambda_1^2$. The first of these is sharp. The results are used to derive relations between the first two eigenvalues in buckling and in vibration of a clamped and a simply supported plate D.

1260

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

[ON THE DIFFERENTIAL EQUATION $u_{xy} = f(x, y, u, u_x, u_y)$. III. THE NON-CHARACTERISTIC INITIAL VALUE PROBLEM] Über die Differentialgleichung $u_{xy} = f(x, y, u, u_x, u_y)$. III. Die nichtcharakteristische Anfangswertaufgabe, by W. [L.] Walter. [1959] [12]p. (AF 49(638)228) Unclassified

Published in Math. Zeitschr., v. 73: 268-279, Apr. 1960.

The existence and uniqueness theorems previously obtained for the Goursat problem (Math. Zeitschr., v. 71: 436-453, 1959; item no. 984, Vol. III) are extended to the non-characteristic initial value problem. A further uniqueness theorem whose hypotheses involve local, rather than global, behavior of the function f is given. (Math. Rev. abstract)

1261

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

THREE-DIMENSIONAL FLOW IN AXIAL TURBOMACHINES, by J. R. Weske. Final rept. Aug. 26, 1960 [5]p. incl. illus. (AFOSR-211) (AF 49(638)385) Unclassified

The objective of this research has been the investigation of the nature of three-dimensional motion associated with the interaction between rotating axial flow blade rows and the working fluid. The investigation pertained to both the subsonic and the transonic regime of flow in turbomachines and has been pursued on both the theoretical and experimental level. The principal experimental investigations were carried out in a variable density recirculating wind tunnel of unique design specially constructed for this project. It is concluded that the spark technique is an effective tool for the investigation of the flow within the blade channels of rotating as well as fixed blade rows of turbomachines. In addition, a quantitative determination of the losses within the blades of rotor or stator rows is possible together with a clear indication of the source and cause of such losses. The experimental techniques applied, principally the spark technique, permit the experimental investigation of certain aspects of three-dimensional flow in turbomachines which have not been accessible in the past.

1262

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ELECTRON DIFFUSION AHEAD OF SHOCK WAVES IN ARGON, by H. D. Weymann. Mar. 1960 [16]p. incl. diagrs. (Technical note no. BN-197) (AFOSR-TN-60-334) (AF 49(638)401) AD 234795; PB 149731 Unclassified

Presented at Twelfth annual Gaseous Electronics Conf., Washington, D. C., Oct. 14-16, 1959.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 125, Mar. 4, 1960. (Title varies)

Also published in Phys. Fluids, v. 3: 545-548, July-Aug. 1960.

Experiments with electrostatic and magnetic probes were performed to investigate the electron diffusion ahead of shock waves of $M_s = 8$ to 12 in argon. Negative electrostatic signals of several v were obtained with pronounced fronts propagating with velocities of up to several times the shock velocity. The current produced by the diffusing electrons was determined from a measurement of the azimuthal magnetic field and found to be of the order of 10^{-5} amp for $M_s = 12$. Assuming that the electron flow velocity is approximately equal to the velocity of the electrostatic front the measured current corresponds to an electron density of $n_e \approx 10^7$ cm^{-3} at about 1 m ahead of the shock front. (Contractor's abstract)

1263

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

EXPERIMENTAL INVESTIGATIONS OF THE INTERACTION BETWEEN A SHOCK AND A MAGNETIC FIELD, by J. P. Barach. Mar. 1960 [29]p. incl. diagrs. tables, refs. (Technical note no. BN-203) (AFOSR-TN-60-439) (AF 49(638)401) AD 236178; PB 147005 Unclassified

A magnetic interaction was observed with flows of Mach number about 15 in krypton and inhomogeneous magnetic field of about 50,000 gauss. The loss of momentum flux in the gas flow is proportional to the magnetic impulse taken up to a point, where there seems to be a sudden adjustment of flow velocity. The position of this point is determined by the parameter $\sigma v B^2/P$. The higher this parameter, the earlier the interaction and the less its total effect. Moderately low values of the parameter produces the largest effects. (Contractor's abstract)

1264

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

THE WAVE MOTIONS OF SMALL AMPLITUDE IN A FULLY IONIZED PLASMA. II. WITH LONGITUDINAL APPLIED MAGNETIC FIELD, by S. I. Pai. Apr. 1960 [28]p. incl. diagrs. (Technical note no. BN-207) (AFOSR-TN-60-576) (AF 49(638)401) AD 237900; PB 148211 Unclassified

Also published in Phys. Fluids, v. 5: 234-240, Feb. 1962.

Wave motions of infinitesimal amplitude in a fully ionized plasma, consisting of single charged ions and electrons, were investigated by a two fluid theory under uniform external magnetic field. The interaction of the basic modes of wave due to external magnetic field is discussed. The case where the external uniform magnetic field is in the direction of propagation of the waves was analyzed in detail. The two basic transverse waves interact with each other so that two different modes of transverse waves are formed. In an ideal plasma, two different undamped transverse waves exist in both the low frequency and the high frequency ranges. In the intermediate frequency range, one or both of the transverse waves may change into exponential damped wave which depends on the ratio of the applied frequency to the charactoristic frequencies, i.e., ion and electron plasma frequencies and ion and electron cyclotron frequencies. The effect of finite electrical conductivity on these transverse waves is briefly discussed. (Contractor's abstract)

1265

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ELECTRON DENSITY DISTRIBUTION IN A CYLINDER, by H. D. Weymann. July 1960 [8]p. incl. diagr. (Technical note no. BN-214) (AFOSR-TN-60-704) (AF 49-(638)401) AD 239342 Unclassified

Also published in Zeitschr. Angew. Math. Phys., v. 12: 82-86, 1961.

In experimental studies of electron diffusion from argon plasmas in shock tubes it has been found that appreciable electron concentrations can be measured up to 1 m ahead of the shock front. As the tube diameter is very small (about 3 cm) compared with the axial extension of the phenomenon (about 100 cm) it may be assumed that the diffusing electrons will establish a quasi-equilibrium density distribution in the radial direction in all but the region directly ahead of the shock. The radial distribution at a given point and instant can then be approximated by the stationary radial distribution of electrons in an infinitely long cylinder provided the mean density over the cross section is the same in both cases. It is found that the density on the axis cylinder approaches a finite value n^*_{max} when the mean density goes to infinity.

1266

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

SOME STUDIES ON ARGON, HELIUM AND CARBON DIOXIDE WITH AN INTEGRATED-SCHLIEREN INSTRUMENTED SHOCK TUBE, by J. Daen and P. C. T. de Boer. Dec. 1960 [41]p. incl. diagrs. tables, refs. (Technical note no. BN-225) (AFOSR-139) (AF 49(638)-401) AD 250675 Unclassified

Also published in Jour. Chem. Phys., v. 36: 1222-1228, Mar. 1, 1962.

Using integrated-schlieren instrumentation, an investigation was made of shock waves in argon, helium and carbon dioxide. In argon and helium a residual signal was observed, which is ascribed to curvature of the shock front in the vicinity of the wall. A discussion is presented of the way in which the curved shock satisfies the boundary conditions, and of the resulting flow pattern, which includes a pressure adjustment region. Preliminary measurements on the variation of the apparent zone thickness with density and shock speed in these gases are reported. The importance of the observed shock curvature in measurements of the vibrational relaxation time for gases like carbon dioxide is considered. Preliminary results for the vibrational relaxation times of dry CO_2 are reported for temperatures up to ca 900°K, and are compared with results obtained by others. (Contractor's abstract)

1267

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

A FUNCTIONAL EQUATION RELATED TO THE BOLTZMANN EQUATION AND TO THE EQUATIONS OF GAS DYNAMICS, by J. M. Burgers. [1960] [29]p. (AFOSR-255, (AF 49(638)401) Unclassified

Also published in Partial Differential Equations and Continuum Mechanics; Proc. Internat'l. Conf., Wisconsin U., Madison (June 7-15, 1960), Madison, Wisconsin U. Press, 1961, p. 289-317.

Some methods of investigation are presented which can be applied to the study of a function $F(\xi; x,t)$. The problem as it is defined can be considered as a greatly simplified model for the Boltzmann equation, the function F representing the so-called distribution function for the particle velocities ξ, giving attention to the dependence of the distribution on the location x and the time t. The equations derived from the function above can also be transformed into an infinite set of partial differential equations for the moments $p_n(x,t)$ of the

function F. By making use of a formal integral of the equation governing the function F, a more general system of expressions for the moments p_n can be constructed. Other cases discussed include where F is independent of x, or is a periodic function of x.

1268

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

INSTRUMENT TO MEASURE DENSITY PROFILES BEHIND SHOCK WAVES, by W. J. Witteman. [1960] [5]p. incl. illus. diagrs. (Technical note no. BN-232) (AFOSR-364) [AF 49(638)401] AD 253129; PB 155363 Unclassified

Also published in Rev. Scient. Instr., v. 32: 292-296, Mar. 1961.

An optical method for the quantitative study of the density distribution behind shock waves has been developed. The method, which uses a photoelectric recording, is based upon the integrated Schlieren method originally devised by Resler and Scheibe. A detailed theoretical analysis is given. Excellent agreement with predicted performance was found in measurements of the density profile behind shock waves in CO_2. The method is very accurate and retains its high sensitivity for weak shocks. The pictures obtained show a nearly exponential approach to equilibrium of the density behind shock waves.

1269

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

VIBRATIONAL RELAXATION IN CARBON DIOXIDE, by W. J. Witteman. [1960] 9p. incl. table. (Technical note no. BN-226) (AFOSR-410) [AF 49(638)401] AD 253294 Unclassified

Also published in Jour. Chem. Phys.. v. 35: 1-9, July 1961.

The vibrational excitation of a CO_2 molecule in collision with another CO_2 molecule is investigated. A derivation of the cross section by means of the method of the distorted waves and the rate of total energy transfer are presented. There are 2 relaxation processes with different relaxation times related to direct excitation of the bending mode and excitation in series of the valence mode. Experimental results confirm this conclusion. The experimental relaxation time for the bending vibration was 1/2 of the calculated value, which may be considered a fair agreement in view of the uncertainty involved in the interaction potential and of other approximations which had to be introduced into the calculations. (Contractor's abstract)

1270

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

THE BOLTZMANN EQUATION FOR FLOWS WITH CHEMICAL REACTIONS, by J. M. Burgers. [1959] [8]p. (AFOSR-611) (AF 49(638)401) Unclassified

Presented at Dedication and Decennial Symposium of the Naval Ordnance Lab., White Oak, Md., May 1959.

Also published in Proc. Conf. on Phys. Chem. in Aerodynam. and Space Flight, Pennsylvania U., Philadelphia (Sept. 1-3, 1959), New York, Pergamon Press, 1961, p. 4-11. (AFOSR-TR-60-106)

Also published in Planetary and Space Sci., v. 9: 4-11, Feb. 1961.

An extended form is presented of the Boltzmann equation for the effect of collisions upon the distribution function, in which account is taken of chemical reactions that may result from collisions and of spontaneous processes (spontaneous change of quantum state with emission of radiation). In order to prevent the scheme from becoming too complicated, a number of assumptions had to be introduced. A discussion is given of the various terms which must be written on the right hand side of the Boltzmann equation. The extended form of the Boltzmann equation in this way can be used for the deduction of continuity, momentum and energy equations, in which the production and the disappearance of molecular species finds a place along with diffusion. (Contractor's abstract)

1271

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

NONSTATIONARY ELECTRON DIFFUSION PROCESSES AHEAD OF STRONG SHOCK WAVES (Abstract), by H. D. Weymann. [1959] [1]p. [AF 49(638)401] Unclassified

Presented at meeting of the Amer. Phys. Soc., Ann Arbor, Mich., Nov. 23-25, 1959.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 131, Mar. 4, 1960.

Detailed investigations with a previously developed electrostatic probe showed that a strongly nonstationary electron diffusion process accompanies the propagation of strong shocks (M_s about 10) into argon. The signals obtained with the electrostatic probe show rather sharp fronts, the velocities of which have been determined as a function of the distance from the shock front and the time. Between the breaking of the diaphragm and the

first appearance of the diffusion signal there is a delay time which depends in a characteristic way on the diaphragm material and the relaxation time for ionization of the gas.

1272

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

THREE-DIMENSIONAL EFFECTS IN THE ELECTRON DIFFUSION AHEAD OF STRONG SHOCK WAVES (Abstract), by H. D. Weymann and A. C. Pipkin. [1959] [1]p. [AF 49(638)401] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Dec. 3-5, 1959.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 316, Apr. 25, 1960.

The electron density profile in a shock-generated plasma is of interest in many respects. It is determined by the ionization rate and the electron diffusion out of the plasma. While shock tube experiments on the ionization rate investigate an essentially 1-dimensional problem, studies of electron diffusion over large distances have to take into account the 3-dimensional character of the electric field generated by the charge separation. Results of experimental and theoretical investigations on the nonstationary diffusion of electrons ahead of strong shock waves will be presented.

1273

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

REMARK ON DILUTE BOSE SYSTEMS, by J. Peretti. [1960] [4]p. incl. diagrs. [AF 49(638)401] Unclassified

Published in Phys. Fluids, v. 3: 68-71, Jan.-Feb. 1960.

Some results are given on the connection existing between the Lee-Huang-Yang theory for the interacting Bose systems, and the Bogoliubov theory.

1274

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

MOTION OF A COMPLETELY IONIZED GAS ACROSS A MAGNETIC FIELD IN THE PRESENCE OF AN ELECTRIC FORCE, by J. M. Burgers. Oct. 1960 [13]p. [AF 49(638)401] Unclassified

Presented at Symposium on Magneto-Fluid Dynamics, Williamsburg, Va. and Washington, D. C., Jan. 18-23, 25, 1960. (AFOSR-303)

Published in Rev. Modern Phys., v. 32: 868-880, Oct. 1960.

Flow equations derived from collisionless Boltzmann equations are employed as a means of studying the one-dimensional steady flow of a fully ionized gas under a transverse magnetic field. Non-isotropic pressure is considered in the treatment. Any continuous transition from one uniform state to another is not manifested in the solution.

1275

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

ELECTRON AND ION DENSITY PROFILES AHEAD OF SHOCK WAVES IN ARGON (Abstract), by H. D. Weymann and B. Troy. [1960] [1]p. [AF 49(638)401] Unclassified

Presented at meeting of the Amer. Phys. Soc., Johns Hopkins U., Baltimore, Md., Nov. 21-23, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 212, Mar. 20, 1961.

Earlier work (item no. 1262) showed that electrostatic precursor signals are associated with electrons diffusing ahead of the shock front. In order to obtain more detailed information on the profiles of the electron and ion densities, a new probe, capable of measuring relative densities in the range 1 to 10^{-8}, was employed. It was found that, up to distances of about 5 cm from the shock front, the electron density and the ion density are equal due to ambipolar diffusion. For distances between 5 and 50 cm the electron density is much larger than the ion density and decreases exponentially with the distance from the shock front. A theoretical treatment of the problem shows that in this latter region $d \ln n_e/dx = -U_s/D_e$ (n_e = electron density, U_s = shock velocity, D_e = electron diffusion constant). Good agreement between theoretical and experimental results can be reached if D_e is calculated with the electron temperature behind the shock front.

1276

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

BOUNDARY-LAYER TRANSITION INDUCED BY A VIBRATING RIBBON ON A FLAT PLATE, by F. R. Hama. Feb. 1960 [32]p. incl. illus. diagrs. refs. (Technical note no. BN-195) (AFOSR-TN-60-290) (AF 49-(638)645) AD 233719; PB 146423 Unclassified

Also published in Proc. 1960 Heat Transfer and Fluid Mech. Inst., Stanford U., Calif. (June 15-17, 1960), Stanford U. Press, 1960, p. 92-105.

Flow patterns associated with the boundary-layer transition induced by a vibrating ribbon are investigated on a flat plate by means of visual observation of the flow of dye in a water tank. When amplified, the perturbation wave rolls up to form discrete vortices in the region near the critical layer. Transition never takes place before the discrete vortices are formed. The initially straight discrete vortices deform into 3-dimensional vortex loops by picking up pre-existing disturbances and amplifying their effects. When the 2-dimensional vortices become stronger, regularity in the transverse direction in forming the vortex loops is quite marked. The vortex loop is continuously stretched and deformed due to the velocity gradient in the boundary layer and probably due to the induction effect of the curved vortex. A turbulence spot is eventually created on the 2 legs and near the forward portion of the loop, but not at the very tip, characterized by a sudden burst of random motion. Mechanism of the final breakdown into turbulence seems to be a chain reaction of successive production of smaller vortex loops on the legs of the initial vortex loop. (Contractor's abstract)

1277

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

PRELIMINARY STUDIES ON BOUNDARY-LAYER TRANSITION CAUSED BY A THIN TRANSVERSE WIRE-FLOATING FROM SURFACE, by F. R. Hama. Apr. 1960 [26]p. incl. illus. diagrs. tables. (Technical note no. BN-208) (AFOSR-TN-60-505) (AF 49(638)645) AD 236776 Unclassified

A thin wire, which is incapable of tripping the flow when it is attached to the surface, was found to cause transition if it is raised from the surface. A rough criterion of provoking transition at the wire is about 200 - 300 for the Reynolds number based upon the velocity at the top of the wire and the distance of the top of the wire from the surface, although it depends on the combination of the wire diameter and the raised distance from the surface. This criterion is approximately the same as that for the conventional trip wire attached to the surface. But a possible merit as a tripping device is that a thick wire is not required to block the entire height. The Reynolds number based upon the velocity at the top and the wire diameter can be as small as 75 to trip the flow at the wire. Important mechanics involved in the arrangement is the following: the flow underneath the wire tends to separate from the surface immediately behind the wire and to break up 3-dimensionally resulting in the formation of longitudinal vortices; transition is provoked by the coupling between the longitudinal vortices and the 2-dimensional vortices formed behind the wire. (Contractor's abstract)

1278

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

SELF-INDUCED VELOCITY OF A CURVED VORTEX, by F. R. Hama and J. Nutant. [1960] [5]p. incl. illus. diagrs. (AFOSR-TN-60-1068) (AF 49(638)645) AD 254783 Unclassified

Presented at meeting of the Amer. Phys. Soc., Johns Hopkins U., Baltimore, Md., Nov. 21-23, 1960.

Also published in Phys. Fluids, v. 4: 28-32, Jan. 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 207, Mar. 20, 1961.

By means of examples the distribution of self-induced velocity along a curved vortex is investigated analytically as well as by means of an analog experiment on the magnetic field of a current-carrying cable. Results verify, at least for these examples, a theorem which was intuitively introduced by Hama in his study of detailed process of boundary-layer transition; the induced velocity on a curved vortex is largest in the region where the curvature is largest. (Contractor's abstract)

1279

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON THE ROLLING-UP OF A VORTEX SHEET, by F. R. Hama and E. R. Burke. Sept. 1960 [29]p. incl. diagrs. (Technical note no. BN-220) (AFOSR-TN-60-1069) (AF 49(638)645) AD 243734 Unclassified

Presented at meeting of the Amer. Phys. Soc., Johns Hopkins U., Baltimore, Md., Nov. 21-23, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 207, Mar. 20, 1961.

Validity of the classical result obtained by Rosenhead (Proc. Roy. Soc. London, v. A134: 170-192, 1931) on the rolling-up of a vortex sheet is examined. His computation is found to be doubtful and does not actually result in the rolling up of the vortex sheet in a simple way. Smaller time intervals must be used for the step-by-step integration of the nonlinear development of the vortex sheet, and, redistribution of the vorticity along the sheet, as it undergoes a sine-wave distortion, has to be taken into account. The vortex sheet is shown to roll up in a more regular manner. Strong concentration of the vorticity does not result. Effect of positive or negative background vorticity on the rolling-up formation is also considered.

1280

Massachusetts General Hospital. Neurophysiological Lab., Boston.

THE APPLICATION OF AUTOCORRELATION ANALYSIS TO ELECTROENCEPHALOGRAPHY, by J. S. Barlow, M. A. B. Brazier, and W. A. Rosenblith. [1959] [13]p. incl. diagrs. (AFOSR-TN-60-1118) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)98, National Institute of Neurological Diseases and Blindness, Office of Naval Research, and Signal Corps) AD 239001 Unclassified

Also published in Proc. of the First Nat'l. Biophysics Conf., Columbus, Ohio (Mar. 1959), Yale U. Press, v. 1: 622-626, 1959.

Autocorrelation analysis, a method of investigation of random signals developed in communications engineering, is applied to the study of brain potentials. For obtaining such correlation functions, a small-scale automatic computer has been designed for the processing of EEG potentials recorded on magnetic tape. The autocorrelation function yields information not readily available by visual inspection of the inked trace, about the statistical characteristics of the EEG, averaged over a period of time, particularly about the inherent rhythmicity of the EEG. This method of analysis represents only one way of handling these data, and can be used as convenient displays in the study of the EEG both in normal human subjects, and in patients with diseases of the brain.

1281

Massachusetts General Hospital. Neurophysiological Lab., Boston.

A SMALL ELECTRONIC ANALOGUE AVERAGER AND VARIANCE COMPUTER FOR EVOKED POTENTIALS OF THE BRAIN, by J. S. Barlow. [1959] [7]p. incl. diagrs. (AFOSR-TN-60-1154) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)98, National Institute of Neurological Diseases and Blindness, and Office of Naval Research) AD 248836 Unclassified

Also published in Medical Electronics, Proc. of the Second Internat'l. Symposium, Paris (France) (June 24-27, 1959), London, Iliffe and Sons, Ltd., 1960, p. 113-119.

Stimuli and brain potentials are recorded simultaneously on a loop of magnetic tape which is then played back repeatedly for analysis. The stimulus pulses are delayed in time with respect to the brain potentials and trigger a circuit that samples and stores the electrophysiological signal. The average value of the step-function output waveform of this circuit is determined for each revolution of the tape and plotted against the corresponding values of the stimulus-delay yielding the average waveform of the responses. The variance of the signal is found by squaring the ac component of the output of the grating and storage circuit before averaging. (Contractor's abstract,

1282

Massachusetts General Hospital. Neurophysiological Lab., Boston.

SOME USES OF COMPUTERS IN EXPERIMENTAL NEUROLOGY, by M. A. B. Brazier. [1960] [21]p. incl. illus. diagr. refs. (AFOSR-TN-60-1334) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)98, National Institute of Neurological Diseases and Blindness; and Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Exper. Neurol., v. 2: 123-143, Apr. 1960.

Attention is drawn to the help that computers can give to the neurophysiologist and the electroencephalographer, not only in the study of normal man and animal, but additionally in the clinical case. Outlined are computer techniques for autocorrelation, crosscorrelation, detection of evoked responses in background activity of higher amplitude, and information about variability. Examples illustrative of these procedures are drawn from animal experimentation, from normal subjects, and from clinical neurophysiology. (Contractor's abstract)

1283

Massachusetts General Hospital. Neurophysiological Lab., Boston.

LONG-PERSISTING ELECTRICAL TRACES IN THE BRAIN OF MAN AND THEIR POSSIBLE RELATIONSHIP TO HIGHER NERVOUS ACTIVITY, by M. A. B. Brazier. [1960] [12]p. incl. illus. (AFOSR-TN-60-1335) [AF 49(638)98] Unclassified

Presented at the Moscow Colloquium on Electroencephalography of Higher Nervous Activity, Moscow (U.S.S.R.), 1960.

Also published in Electroencephalog. and Clin. Neurophysiol. Jour., Suppl. 13: 347-358, 1960.

Autocorrelation was employed to determine the possible existence of any electrical trace of some rhythmic activity in the brain that could be secondary to the mechanism subserving the capability of the nervous system to estimate the passage of time. Rhythms of various frequencies seem to be present in the different parts of the head, giving the brain more possible tools for matting time sequences. Incoming sensory impulses may register on the brain by a contrast in phase to that of its alpha rhythm and by a complexity of frequency change that cannot be assigned to a single factor.

1284

Massachusetts General Hospital. [Neurophysiological Lab.] Boston.

FACILITATION OF ACCURATE PERCEPTION BY ANTICIPATORY SETS: THE PROGRESSIVE EFFECTS OF AGING, by G. A. Talland. [1959] [12]p. incl. tables, refs. (AFOSR-TN-60-1336) (AF 49(638)98) Unclassified

Also published in Gerontologia, v. 3: 339-350, 1959.

The effect of anticipatory sets on accuracy of perception was tested in 3 different groups: group one consisted of men aged 77-89 yr, group two was a mixed group aged 65-75 yr and group three (control) was a mixed group aged 20-40 yr. Anticipatory sets facilitated accurate auditory perception in all groups and subjects at all 3 age levels were able to formulate expectancies from the cues given them. Performance scores diminished with age, but the relative effect of the test situations remained stable. When the task involved the rapid shifting from one set to another or when a new set was formulated while another was still in operation, age effects unfavorable to performance manifested themselves first. In subjects over 77 yr, significant deterioration was noted in the utilization of single sets. Inter-subject variability tended to increase with age, and so did cautiousness in making a response. (Contractor's abstract)

1285

Massachusetts General Hospital. Neurophysiological Lab., Boston.

THE REACTIVITY OF THE NERVOUS SYSTEM IN THE LIGHT OF THE PAST HISTORY OF THE ORGANISM, by M. A. B. Brazier, K. F. Killam, and A. J. Hance. [1959] [18]p. incl. diagrs. refs. (AFOSR-1329) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)98, National Institute of Neurological Diseases and Blindness, and Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Sensory Communication; Contributions to the Symposium on Principles of Sensory Communication, Endicott House, M.I.T. (July 19-Aug. 1, 1959) [Cambridge] M.I.T. Press, 1961, p. 699-716. (AFOSR-796)

The position is taken that the response of the brain to sensory stimulation depends more importantly on events within the brain than on the extracorporeal parameters of the stimulus. Not only do current activities in brain mechanisms influence the response, but past experience also has its effect. Three series of experiments are described to illustrate the influence of past experience on the reactivity of the brain to standard stimuli. As a general conclusion the proposal is made that the so-called temporary connections set up by intersensory conditioning are not in fact temporary, but already existing connections whose responses are augmented by use. These responses often lie hidden below the noise level of the usual recording but can be revealed if processed through a computer that increases the signal-to-noise ratio. (Contractor's abstract, modified)

1286

Massachusetts General Hospital. [Neurophysiological Lab.] Boston.

AUTOCORRELATION AND CROSSCORRELATION TECHNIQUES IN EEG ANALYSIS, by J. S. Barlow. [1960] [6]p. incl. diagrs. refs. (AFOSR-J1002) (In cooperation with Massachusetts Inst. of Tech., Research Lab of Electronics, Cambridge) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)98, Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and National Institute of Neurological Diseases and Blindness) AD 418297 Unclassified

Also published in Computer Techniques in EEG Analysis; Proc. of Conf., California U., Brain Research Inst., Los Angeles (Oct. 29-30, 1960), New York, Elsevier Publishing Co., 1961, p. 31-36.

Also published in Electroencephalog. and Clin. Neurophysiol. Jour., Suppl. 20: 31-36, 1961.

Autocorrelation results for normal subjects can be used as reference for study of the nature of EEG changes that appear during the administration of drugs, during sleep and in disease states. By means of crosscorrelation analysis, it is possible to study quantitatively relationships between the electrical activity from 2 different recording sites. Possible relationships between unit discharges and slow waves can also be investigated by means of crosscorrelation analysis of simultaneous recordings in order to determine whether any components of the slow wave are consistently related to some of the unit potentials. The above principles can also be applied to the study of the central-peripheral relationships in the neuromuscular systems.

1287

Massachusetts General Hospital. [Neurophysiological Lab.] Boston.

RECORDING OF SINGLE UNIT ACTIVITY IN ISOLATED CENTRAL NERVOUS TISSUE, by A. Ames, III and B. S. Gurian. [1960] [2]p. incl. diagrs. (AFOSR-64-0168) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)98 and National Institute of Mental Health) AD 432734 Unclassified

Published in Science, v. 133: 1767-1768, June 2, 1961.

The retina and attached segment of optic nerve isolated from the rabbit were maintained in a functioning state in vitro. Microelectrodes, introduced into the nerve,

recorded unit discharges in response to eight stimuli. The polarity of the responses was positive with respect to the gross electrode. The responses were sharply peaked, having an amplitude ranging from 0.05 to 0.3 mv. The uniform amplitude of the responses recorded from a given site indicated that a single unit was being sampled, though occasionally, responses of 2 amplitudes, suggesting simultaneous recording of 2 units, were observed.

1288

Massachusetts General Hospital. Neurophysiological Lab., Boston.

SOME ACTIONS OF ANESTHETICS ON THE NERVOUS SYSTEM, by M. A. B. Brazier. [1960] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)98, National Institute for Neurological Diseases and Blindness, and Office of Naval Research) Unclassified

Presented at Symposium on Physiology and Drug Action, Chicago, Ill., Apr. 12, 1960.

Published in Fed. Proc., v. 19: 626-628, July 1960.

The averaging technique is used to demonstrate the scatter of individual responses in anesthetized and unanesthetized cats to single stimuli. Wave-like responses to flash are found in recordings made from the cingulate cortex of an unanesthetized cat and in the same animal under each of three anesthetics. Responses to the same stimuli are also recorded in the reticular formation. Under pentobarbital the wave-like response reaches a peak at about 20 msec after the flash. The wave-like responses of the non-specific cortex reach their peaks at approximately 37 msec. Similar responses are found in the reticular formation in tribromethanol anesthesia and in ether.

1289

Massachusetts General Hospital. [Neurophysiological Lab.] Boston.

TOWARD A REALISTIC MODEL OF A BIOLOGICAL PERIOD-MEASURING MECHANISM, by C. F. Ehret and J. S. Barlow. [1960] [4]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)98, National Institute of Neurological Diseases and Blindness, Office of Naval Research, and Signal Corps) AD 252567 Unclassified

Also published in Cold Spring Harbor Symposia on Quantitative Biology, Cold Spring Harbor, N. Y. (June 5-14, 1960), New York, Long Island Biological Assoc., Inc., v. 25: 217-220, 1960.

A model of a biological period-measuring mechanism has been devised and includes the following steps: (1) synthesis of polynucleotides within the nucleus along the chromatin, polymerization of RNA, (2) lamination of RNA and protein to form RNP granules, (3) diffusion of granules to cytoplasm, (4) synthesis of protein at RNP-substrate interfaces, (5) formation of lipoprotein lamellates by lamination of protein-lipid, (6) diffusion of these laminated structures to the nucleus, (7) step one begins again. The length of the entire cycle is 24 hr, 40 min. Inhibitors have a relatively small effect on the mechanism, similar to but less than that of temperature.

1290

Massachusetts General Hospital. [Neurophysiological Lab.] Boston.

CATECHOL AMINE EXCRETION BY DUODENAL ULCER PATIENTS, by W. R. Waddell, G. D. Zuidema, and G. M. Smith. [1960] [6]p. incl. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)98, Harvard School of Public Health, and U.S. Public Health Service) Unclassified

Published in Jour. Clin. Invest., v. 39: 834-839, June 1960.

An evaluation was made of autonomic function in ulcer patients and in normal subjects by determination of urinary excretion of free epinephrine and norepinephrine. Excretion of epinephrine and norepinephrine was lower in ulcer patients than in control subjects under basal conditions and after stimulation with peptone broth and insulin. Ulcer patients had high volume, higher titratable acidity of gastric juice and lower pH than the controls. Generally, changes in gastric secretion were not found to be correlated with changes in catechol output. In a second group of ulcer patients and controls, there was no significant difference in the epinephrine and norepinephrine output during the day. The night urine samples of ulcer patients contained significantly less norepinephrine than those of control subjects. Ulcer subjects tended to excrete less norepinephrine per unit of urine than controls under all conditions in both experiments. The differences were significant only after stimulation with insulin in experiment one and during accumulation of night samples in the second experiment. (Contractor's abstract, modified)

1291

Massachusetts General Hospital. [Neurophysiological Lab.] Boston.

MEASUREMENT OF FUNCTION IN AN IN VITRO PREPARATION OF MAMMALIAN CENTRAL NERVOUS TISSUE, by A. Ames, III and B. S. Gurian. [1960] [16]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)98 and National Institute of Mental Health) Unclassified

Published in Jour. Neurophysiol., v. 23: 676-691, Nov. 1960.

A preparation of retina and attached optic nerve from the rabbit is described in which action potentials can be recorded for several hr in vitro. Certain characteristics of the responses to temperature change and light sensitivity are shown and the possibility of using it as a model of the brain, suited to in vitro study is discussed. (Contractor's abstract)

1292

Massachusetts General Hospital. Neurophysiological Lab., Boston.

ELECTROGRAPHIC RECORDING AND CORRELATION ANALYSIS FROM DEEP STRUCTURES WITHIN THE HUMAN BRAIN, by M. A. B. Brazier, R. N. Kjellberg and others. [1960] [23]p. incl. illus. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)98, National Institute of Neurological Diseases and Blindness, and Office of Naval Research) Unclassified

Published in Electrical Studies on the Unanesthetized Brain, A Symposium, Georgetown U., Washington, D. C. [1960], New York, Harper & Brothers, 1960, p. 311-313.

Electrophysiologic studies of the basal ganglia, ancillary to a therapeutic procedure in patients with Parkinson's disease, are carried out by a precise stereotactic placement of the recording points. Delgado electrodes are used on all cases except the first. All brain potentials are recorded simultaneously from the medial globus pallidus on an ink-writing oscillograph and on a 7-channel magnetic tape recorder. The latter record is then subjected to correlation analysis. The four patients studied are analyzed for their major symptons and the crosscorrelation results are still being developed.

1293

Massachusetts Inst. of Tech., Cambridge.

THE INDEX THEOREM IN RIEMANNIAN GEOMETRY, by W. Ambrose. [1960] [38]p. (AFOSR-3300) [AF 18-(603)91] AD 428341 Unclassified

Also published in Ann. Math., v. 73: 49-86, Jan. 1961.

The Morse focal point theorem is extended to the case of 2 variable end points. Morse's theorem says the number of different shorter routes which lie near a geodesic segment from a manifold perpendicular to a point on the segment to another point is the sum of the orders of the focal points of the manifold along the segment. Some of Morse's conditions are accepted and extended and the proof follows in broad outline his proof, although it is more complicated. The new aspects of this proof are: (1) the notion of a translate of a boundary condition; (2) notion of a conjugate point of an ordered pair of boundary conditions; (3) a simple lemma which adequately replaces the calculus of variations in matters considered; (4) an analytical discussion of the growth of the index functions. The resulting index theorem is: Let S and T be an ordered pair of boundary conditions, S at a and T at b, and I the associated index form. Then the index of I on the corresponding linear spaces is the convexity plus the sum of the orders of the conjugate points between a and b.

1294

Massachusetts Inst. of Tech., Cambridge.

THE CARTAN STRUCTURAL EQUATIONS IN CLASSICAL RIEMANNIAN GEOMETRY, by W. Ambrose. [1958] [54]p. (AFOSR-3301) (In cooperation with Institute for Advanced Study, Princeton, N. J.) (AF 18(603)-91) Unclassified

Also published in Jour. Indian Math. Soc., v. 24: 23-76, Mar.-June 1960.

There are two approaches to Riemannian geometry: the Calculus of Variations approach which emphasizes metric properties and the theory of connections which emphasizes group theoretic aspects. It is the aim of this paper to demonstrate how the metric properties can be obtained from the theory of connections, thus eliminating the need for the classical Calculus of Variations in Riemannian geometry. In particular, the way in which the various properties of geodesics and Jacobi fields follow from the Cartan structural equations is demonstrated. All definitions and elaborations of differentiable structures are omitted but all aspects of Riemannian structures, beyond the differential structure, are given in detail, except for material on connections which is easily available elsewhere.

1295

Massachusetts Inst. of Tech., Cambridge.

SPRAYS, by W. Ambrose, R. S. Palais, and I. M. Singer. [1960] [16]p. (AFOSR-3302) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)-91] and National Science Foundation) Unclassified

Also published in Anais Acad. Brasil. Cien., v. 32: 163-178, June 30, 1960.

If an affine connection is given over a manifold, it determines a spray of geodesics emanating from each point. This spray enables certain second order tangent vectors called pure second order to be singled out. The object of this paper is to prove, conversely, that every pointing out of these certain second order tangent vectors, called dissecting of these vectors, arises in a way from the spray of geodesics of an affine connection and that the spray is uniquely determined by the dissection. Several theorems are proved, among them the properties of a spray and torsion tension of a unique affine connection over a C^∞ manifold and when there is a unique spray

and what induces it. Under what conditions 2 affine connections will have the same spray of geodesics is also discussed.

1296

Massachusetts Inst. of Tech., Cambridge.

MAXIMAL ALGEBRAS OF CONTINUOUS FUNCTIONS, by K. Hoffman and I. M. Singer. [1959] [25]p. incl. refs. (AF 18(603)91 and AF 49(638)42) Unclassified

Published in Acta Math., v. 103: 217-241, 1960.

Known examples of essential maximal algebras, all of which stem from algebras of analytic functions, are listed, followed by an analysis of pervasive algebras and their properties. The representation of complex homomorphisms of an algebra by positive measures on the Silov boundary, are discussed with particular emphasis placed on the usefulness of such representations in the study of maximal algebras. Various tests for the maximality of a given algebra A in a subalgebra C(Γ) are described and a particular example of a proper algebra A not contained in any maximal algebra is exhibited.

1297

Massachusetts Inst. of Tech., Cambridge.

SUBLIMATION MASS TRANSFER THROUGH COMPRESSIBLE BOUNDARY LAYERS ON A FLAT PLATE, by T. K. Sherwood and O. Trass. [1960] [12]p. incl. illus. diagrs. table, refs. [AF 49(638)234] Unclassified

Presented at annual meeting of the Amer. Soc. Mech. Eng., Atlantic City, N. J., Nov. 29-Dec. 4, 1959.

Published in Jour. Heat Transfer, v. 82: 313-324, Nov. 1960.

Data are reported on rates of sublimation mass transfer from an adiabatic, sharp-edged flat plate exposed to air streams at Mach numbers of 0.43, 2.0, and 3.5. Thickness decrease of the subliming naphthalene coating, plate surface temperature, and flow conditions were measured. An analysis of friction and heat transfer in turbulent compressible flow has been extended to mass transfer at low rates. Agreement between theory and data is good over the entire range of Reynolds numbers from 3×10^4 to 9×10^6. The effect of compressibility on mass transfer is found to be slightly greater than on friction. The measurement of the sublimation rate of thin coatings of solids provides a powerful technique of obtaining local friction coefficients, being simpler and of a wider applicability than the method involving force measurements on small floating surface elements. (Contractor's abstract)

1298

Massachusetts Inst. of Tech. Aeroelastic and Structures Research Lab., Cambridge.

YIELD CONDITIONS OF PLATES AND SHELLS BY MISES-HENCKY CRITERION, by T. H. H. Pian. June 1960, 13p. incl. diagrs. (ASRL-TR-76-3) (AFOSR-TN-60-608) (AF 49(638)160) AD 239634 Unclassified

Yield conditions for plates and shells under combined bending moments and stress resultants were derived by using Mises-Hencky criterion. The relation is expressed in parametric form with three parameters. For several limiting cases, simple yielding conditions are obtained. (Contractor's abstract)

1299

Massachusetts Inst. of Tech. Aeroelastic and Structures Research Lab., Cambridge.

SNAPPING OF SHALLOW SPHERICAL SHELLS UNDER STATIC AND DYNAMIC LOADINGS, by J. Suhara. June 1960, 72p. incl. diagrs. refs. (ASRL-TR-76-4) (AFOSR-TN-60-831) (AF 49(638)160) AD 242208 Unclassified

A study of finite deformations of clamped shallow spherical shells subjected to static and dynamic loadings is presented. The solutions of the static problem are obtained by means of both the variational method and the method of expansion in the series of combined Legendre's polynomials. The results are compared with those obtained by Keller and Reiss (Jour. Aero/Space Sci., v. 25: 643-652, Oct. 1959). Fairly good agreements of both results are obtained for unbuckled branch in the static cases. Dynamic behavior of shallow spherical shells which undergo suddenly applied uniform pressure of infinite duration are investigated using 2 different methods. In the first a simple trial function for the deformation mode is assumed and the dynamic equation is obtained by variational method; the equation is then solved by means of an electronic analogue computer. Other trials are made to estimate the dynamic maximum deformations due to a given dynamic load. The principle of conservation of energy is used in this case. The analyses involve 2 sets of solutions, a simple trial function, and Legendre's polynomials solutions obtained previously for the static problem. Estimations of the dynamic snapping loads are given for shells of two kinds of shallowness. (Contractor's abstract)

1300

[Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.]

CRITERION FOR rTH POWER RESIDUACITY, by N. C. Ankeny. [1960] [10]p. (AF 18(603)90) Unclassified

Published in Pacific Jour. Math., v. 10: 1115-1124, 1960.

Let r be an odd prime. Let p and q be primes such that $p \equiv q \equiv 1 \pmod r$. Let $\Sigma_1^{(k)}$ denote the sum over all $j_1,\ldots,j_{k+1} = 1, 2,\ldots, r-1$, such that $j_1 + \ldots + j_k - kj_{k+1} \equiv 1 \pmod r$. A system is presented to show that it contains exactly r-1 distinct solutions in rational integers. Let $\{X_j = a_j,\ 1 \le j \le r-1\}$ be any one of these solutions, and let h be any integer such that $h^r \equiv 1 \pmod q$, $h \not\equiv 1 \pmod q$. Then q is an r^{th} power modulo p if and only if $p\Sigma a_j h^j$ is an r^{th} power modulo q. Moreover, r is an r^{th} power (mod p) if and only if $\Sigma j a_j + 1/2 r a_{r-1} \equiv 0 \pmod{r^2}$. The determination of solutions of the system is formidable, even for moderate values of r. (Math. Rev. abstract)

1301

Massachusetts Inst. of Tech. [Dept. of Mathematics, Cambridge.]

SYMMETRIC PRODUCTS AND JACOBIANS, by A. Mattuck. [1960] [18]p. incl. refs. (AF 18(603)90) Unclassified

Published in Amer. Jour. Math., v. 83: 189-206, Jan. 1961.

Let C(n) be the n-fold symmetric product of an algebraic curve C. For $n > 2g-2$ the map $C(n) \to J$ from C(n) onto the Jacobian variety of J of C determines an algebraic projective bundle over J whose fibers are the linear systems. The Chern classes of this bundle are exhibited as elements of the rational equivalence ring A(J) of J. The structure of the ring A(C(n)) is given as an extension of A(J). In particular, one obtains the structure of homology rings of high symmetric products of the closed orientable topological surfaces "which have hitherto been computed 'in principle' by the use of Eilenberg-McLane spaces". Certain intersection relations are obtained from which the intersection formulas for W_1 of Weil-Matsusaka can be derived as well as the formulas used by Weil in his proof of the Riemann hypothesis.

1302

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

DEFINITE QUADRATIC FORMS, by N. C. Ankeny. [1960] [32]p. incl. refs. (AF 18(603)90) Unclassified

Published in Proc. London Math. Soc., v. 11: 353-384, Apr. 1961.

A new proof of Siegel's genus representation formulas of integers, m, is given by quadratic forms F in n variables with integral coefficients; namely, $\Sigma N(F_j,m)N(F_j,F_j)^{-1} = K\,\Pi Mq(F,m)Mq(F,F)^{-1}$, $\Sigma N(F_j,F_j)^{-1} = L\,\Pi Mq(F,F)^{-1}$, where the sums are over a set of inequivalent matrices in a genus, the products over all primes q, and K and L are explicitly given functions of n and the determinant of F. Here N(F,m) is the number of integral representations of m by F, N(F,F) the number of integral automorphisms of F, and the corresponding Mq are, except for a power of q, the number of representations and automorphisms mod q^c, independent of c for C sufficiently large?

1303

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

UNIFORMLY BOUNDED REPRESENTATIONS AND HARMONIC ANALYSIS OF THE 2 x 2 REAL UNIMODULAR GROUP, by R. A. Kunze and E. M. Stein. [1958] [62]p. incl. refs. (AF 49(638)42) Unclassified

Published in Amer. Jour. Math., v. 82: 1-62, Jan. 1960.

A family of uniformly bounded representations of the group is constructed with the following properties: They all act on a fixed Hilbert space $\mathcal{H}$; they are determined by a complex parameter s, $0 < R(s) < 1$, and depend analytically on the parameter s; finally, when $R(s) = 1/2$, these representations are, up to unitary equivalence, the continuous principal series. The implication of this family with regard to the Fourier analysis of the group is considered. The above properties, especially the analyticity, together with certain convexity arguments applied to operator valued functions yield the following: (1) The "Fourier-Laplace" transform of a function f in $L_1(G)$ exists as an operator-valued function $\mathcal{F}$, whose values $\mathcal{F}(s)$ act on $\mathcal{H}$, and which is analytic in s, $0 < R(s) < 1$. (2) When $f \in L_p(G)$, $1 \le p < 2$, the Fourier-Laplace transform $\mathcal{F}$ can still be defined, and is an operator valued function analytic in the strip, $1 - 1/p < R(s) < 1/p$. (3) A detailed analysis of the proofs of the above reveals the remarkable fact: If $f \in L_p(G)$, $1 \le p < 2$, the Fourier-Laplace transform $\mathcal{F}$ of f is uniformly bounded in the operator norm along the line $R(s) = 1/2$. The paper is then presented in 4 chapters. (I) Operator valued functions: The basic convexity (interpolation) theorems are proved and are general in nature. However, the proof of the main interpolation theorem is tailored to fit the situation which arises in the 2 x 2 real unimodular group. (II) Uniformly bounded representations: The actual construction of the family of representations is given. The general background and theorems are stated. Their proofs, however, require some extensive Fourier analysis. (III) The Fourier-Laplace transform on the group: Combining the results of (I) and (II), the Fourier-Laplace transform for the group is studied. This leads to an extension of the Hausdorff-Young theorem. The Fourier analysis of a function on the group by a consideration of the discrete

series is completed. (IV) Some applications of the above are given. It concerns with the theorem that convolution by a function in L_p, $1 \leq p < 2$, is a bounded operator on L_2. Some implications of this result are also deduced. Finally, it deals with characterizations of various representations of the group and with a related notion —the "extendability" of a representation to L_p.

1304

[Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.]

ON THE ALTERNATING DIRECTION METHOD FOR SOLVING THE PLATE PROBLEM WITH MIXED BOUNDARY CONDITIONS, by S. D. Conte and R. T. Dames. [1959] [10]p. incl. diagr. tables. (AF 49(638)-42) Unclassified

Published in Jour. Assoc. Comput. Mach., v. 7: 264-273, July 1960.

Previous results for the numerical solution of simply supported biharmonic equations are extended by analyzing more general boundary conditions. For rectangular regions, in addition to W (the deflection) being specified along the entire boundary, any combination of either of the normal derivatives W_n or W_{nn} can be prescribed, each along a complete side. By embedding the rectangular region into a larger square region with simply-supported boundary conditions, Courant's min-max characterization for the eigenvalues of Hermitian matrices is employed to show that the Douglas-Qachford iterative method for a single fixed parameter applied to the biharmonic equation in the original rectangular region is necessarily convergent.

1305

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

GENERALIZED TOPOLOGIES FOR STATISTICAL METRIC SPACES, by E. Thorp. [1960] 22p. (AFOSR-TN-60-356) (AF 49(638)42) PB 147164 Unclassified

Also published in Fundamenta Math., v. 51: 9-21, 1962/63.

Statistical metric spaces are a generalization of metric spaces (with the metric changed to a collection of distribution functions). The distribution function F(p,q) associated with a pair of points (p,q) in S is denoted by $F_{p,q}$, and is used to map S x S into the set of distribution functions (i.e., real-valued functions of a real variable which are everywhere defined, nondecreasing, left-continuous and have inf 0 and sup 1). Canonical maps, a class of generalized topologies, and the generalized ecart topology are topics developed.

1306

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

FUNDAMENTAL GROUPS ON A LORENTZ MANIFOLD, by J. W. Smith. [1960] 33p. (AFOSR-TN-60-357) (AF 49(638)42) AD 236407; PB 147165 Unclassified

Also published in part in Proc. Nat'l. Acad. Sci., v. 46: 111-114, Jan. 1960. (AFOSR-3374)

Also published in Amer. Jour. Math., v. 82: 873-890, Oct. 1960.

Let V denote a differentiable manifold of dimension $n \geq 2$ and class C^p, $2 < p \leq \infty$. A metric Lorentz structure L on V is a second order symmetric covariant tensor field of class C^n, $2 \leq n \leq p$, and signature (2-n). Conformal global properties of the Lorentz structure which are described by means of an infinite collection of groups are studied. Certain loop spaces $T_1(L,x)$ are defined and taken as a starting point of the investigation. A loop space is defined as a set of loops having a common base point, together with a law of multiplication, which gives rise to a group T. Four theorems concerning the T-groups are proved: (1) a general connection is established between the T-groups and the fundamental group of V, (2) and (3) the dependence of the new groups on base point is considered, and (4) what happens when the Lorentz structure is flat and complete is discussed.

1307

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

SINGULAR INTEGRAL EQUATIONS, BOUNDARY VALUE PROBLEMS AND THE RIEMANN-ROCH THEOREM, by W. Koppelman. [1960] [45]p. incl. refs. (AFOSR-TN-60-587) (AF 49(638)42) AD 238232; PB 148538 Unclassified

Also published in Jour. Math. and Mech., v. 10: 247-277, Mar. 1961.

A study is presented to encompass, simultaneously, the Hilbert problem, the Riemann-Hilbert problem, the subject of 1-dimensional singular integral equations, and the Riemann-Roch theorem. Various interrelations between these 4 subjects are obtained. The Hilbert problem is treated by means of singular integral equations, and the classical Riemann-Roch theorem is obtained as a corollary. A discussion is also presented of the Riemann-Hilbert problem and the Hilbert and Riemann-Hilbert problems for vectors. A proof of the results for the Hilbert problem is given, using the Riemann-Roch theorem as a tool. (ASTIA abstract)

1308

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

THE CATEGORY OF TOPOLOGICAL OBJECTS, by Y. H. Clifton and J. W. Smith. [1960] [6]p. (AFOSR-3294) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)42 and National Science Foundation) Unclassified

Also published in Proc. Nat'l. Sci., v. 47: 190-195, Feb. 1961.

A certain category $\mathfrak{C}$ is introduced which extends the category C of topological spaces. It is shown how every subcategory C_0 of C can be canonically extended to a larger subcategory $\mathfrak{C}_0$ of $\mathfrak{C}$. The problem of extending classical theories from a subcategory C_0 to the subcategory $\mathfrak{C}_0$ by considering cohomology theories arising from a sheaf-valued functor is considered.

1309

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

A NOTE ON THE JOINT SPECTRAL RADIUS, by G.-C. Rota and W. G. Strang. [1960] [3]p. (AFOSR-3295) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)42 and Office of Naval Research) Unclassified

Also published in Koninkl. Nederl. Akad. Wetensch. Proc., Indag. Math., Series A, v. 63: 379-381, 1960.

Let B be any bounded subset of the normed algebra $\mathfrak{A}$ with identity e. Let P_n be the set of all elements of $\mathfrak{A}$ which are the products of n elements of B. The joint spectral radius of the set B is defined to be the non-negative number $r(B) = \lim_{n\to\infty} \sup_{T\in P_n} \|T\|^{1/n}$. A result is proven connecting the joint spectral radius with the equivalent norms that the algebra may be provided with.

1310

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

AN EMBEDDING OF RIEMANN SURFACES OF GENUS ONE, by A. M. Garsia and E. Rodemich. [1960] [12]p. incl. diagrs. (AFOSR-64-2485) (In cooperation with Minnesota U., Minneapolis) (AF 49(638)42) Unclassified

Also published in Pacific Jour. Math., v. 11: 193-204, 1961.

The following theorem is proven: Any compact Riemann surface of genus one can be embedded as a C^∞ manifold in 3-space. First, a singular embedding is obtained by an ingenious folding and glueing of the fundamental parallelogram. Then this torus, S_0, with modulus ω_0, is deformed into a C^∞ torus, S with modulus ω, which is non-singularly embedded. A complicated elementary argument shows that this deformation can be accomplished so that when ω_0 ranges over a compact set in the fundamental region of the modular function, ω is a continuous function of ω_0 and $|\omega - \omega_0| < \epsilon$, where ϵ can be arbitrarily small. The result then follows by a degree argument.

1311

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

THE CALCULATION OF CONFORMAL PARAMETERS FOR SOME IMBEDDED RIEMANN SURFACES, by A. M. Garsia. [1960] [45]p. (AF 49(638)42) Unclassified

Published in Pacific Jour. Math., v. 10: 121-165, 1960.

There exists a known and natural way which assigns to each Riemann surface of genus 1 a point z in the region $\{z: Iz < 0$, and either $-\frac{1}{2} < Rz < 0$ and $|z| > 1$ or $0 \le Rz \le \frac{1}{2}$ and $|z| > 1\}$; one sets z equal to the ratio of 2 principle periods of a suitably chosen Abelian differential. The existence of such surfaces for which $Rz \neq 0$ has already been proven indirectly. A class of surfaces M, each subject to the Schottky uniformization and each imbedded in E_3, is constructed. From this class is furnished the first examples of surfaces of genus 0 for which $Rz \neq 0$. The parameters involved in the uniformization permit classification of the conformal structure of surfaces in M. It is stated that M "may contain all conformal types", but "the question still remains open whether or not every Riemann surface has a conformally equivalent representative in the E_3."

1312

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

A FAVORABLE STRATEGY FOR TWENTY-ONE, by E. Thorp. [1960] [3]p. incl. tables. (AF 49(638)42) Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 47: 110-112, Jan. 1961.

A favorable strategy for twenty-one has been outlined according to a modification of a method calculated by Baldwin et al., (Jour. Amer. Stat. Assoc., v. 51: 429-439, 1956). Improvements over Baldwin's procedure include: (1) the programming of a high-speed computer in order to find the player's best possible strategy and the corresponding expectation, and (2) the programming of the computer to perform calculations for arbitrary sets of cards. Since this strategy offers a spectrum of favorable expectations, it seems reasonable to let the size of the bets increase with the expectation.

1313

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

CONSTRUCTIVE VERSIONS OF ORDINAL NUMBER CLASSES, by D. L. Kreider and H. Rogers, Jr. [1960] [45]p. incl. refs. (AFOSR-3975) (AF 49(638)76) AD 290682 Unclassified

Also published in Trans. Amer. Math. Soc., v. 100: 325-369, Aug. 1961.

Certain terminology and background related to the classical theory of ordinals is provided. Systems 1 and 3 and the general notion of system of notations are discussed. Certain peculiarities of the Addison-Kleene extension of S_3 (system 3) are considered. S_1 is extended and it is shown that iteration of the hyper-jump over this extension does not lead beyond sets in the two-function-quantifier forms.

1314

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

A NOTE ON GROUP VELOCITY, by G. B. Whitham. [1960] [6]p. incl. diagr. (AFOSR-140) (AF 49(638)708) AD 251050 Unclassified

Also published in Jour. Fluid Mech., v. 9: 347-352, Nov. 1960.

The kinematic approach to group velocity given in Lighthill and Whitham (Proc. Roy. Soc., v. 229A: 281-316, May 10, 1955) for 1-dimensional waves is extended to cover the general 3-dimensional case. The ideas have particular bearing on the theory developed by Ursell (J. Fluid Mech., v. 9: 333-346, Nov. 1960) for treating steady wave patterns on non-uniform steady fluid flows. (Contractor's abstract)

1315

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

ON LONGITUDINAL MOTION IN A MAGNETIC FIELD, by H. P. Greenspan. [1960] [10]p. incl. diagrs. (AFOSR-141) (AF 49(638)708) AD 251051 Unclassified

Also published in Jour. Fluid Mech., v. 9: 455-464, Nov. 1960.

An exact solution is presented of the equations and boundary conditions governing the steady longitudinal motion of a semi-infinite non-conducting plate in an oblique magnetic field. The discussion covers the distortion of the boundary layer, the structure of the induced electric and magnetic fields, the current-density distribution, and the behavior of the fields near the edge of the plate. (Contractor's abstract)

1316

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

ON THE FLOW OF A VISCOUS ELECTRICALLY CONDUCTING FLUID, by H. P. Greenspan. [1960] [4]p. incl. diagr. (AFOSR-551) (AF 49(638)708) AD 255648 Unclassified

Also published in Quart. Appl. Math., v. 18: 408-411, Jan. 1961.

The Oseen equations governing the steady 2-dimensional flow past a flat plate in the presence of a parallel applied magnetic field can be solved in very simple terms using a coordinate system and a form of the solution similar to that used when the magnetic field is absent. The solution brings out the flow properties including the difference between sub-Alfvén and super-Alfvén flow.

1317

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

THE SLOW FLOW OF A VISCO-ELASTIC LIQUID PAST A SPHERE, by F. M. Leslie. [1960] [13]p. incl. diagrs. (In cooperation with Manchester U. (Gt. Brit.)) (AF 49(638)708) Unclassified

Published in Quart. Jour. Mech. Appl. Math., v. 14: 36-48, Feb. 1961.

A solution is obtained for the steady flow of a visco-elastic liquid past a sphere at small Reynolds number. The drag is found to be less than that given by Stoke's formula for a Newtonian liquid of the same viscosity. (Contractor's abstract)

1318

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

A NOTE ON THE CONCEPT OF ENTROPY, by I. E.

Segal. [1960] [7]p. (AFOSR-3667) (In cooperation with Chicago U., Ill.) [AF 49(638)945] Unclassified

Also published in Jour. Math. and Mech., v. 9: 623-629, July 1960.

Let A be a ring of operators on a complex Hilbert space H and let a regular state E of A be a state which is continuous in the strong operator topology. The entropy of E with respect to a distinguished gage m on A is -m (D log D) if the last exists as an extended real number and D = dE/dm. If D is a bounded operator, then E is a bounded state. Theorem 1 states that the entropy is a concave function on bounded states. Theorem 2 postulates that the entropy of the restriction of a bounded state to a subring is not less than the entropy of the original state. States of maximal and minimal entropy are given for particular rings. (Math. Rev. abstract)

1319

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

TRAVELLING CRACKS IN ELASTIC MATERIALS UNDER LONGITUDINAL SHEAR, by F. A. McClintock and S. P. Sukhatme. [1960] [7]p. incl. diagrs. (AF 18-(600)957) Unclassified

Published in Jour. Mech. and Phys. Solids, v. 6: 167-193, Aug. 1960.

The solution for the stress field around the tip of a crack subjected to longitudinal shear (antiplane strain) and traveling with a constant velocity in an elastic medium was extended to a configuration analogous to the tensile case studied by Craggs (Jour. Mech. and Phys. Solids, v. 8: 66-75, Jan. 1960). As in the case of tensile cracks, the applied stress required for constant velocity is lower for higher crack velocity and there is a critical velocity approximately 0.6 times that of the shear wave velocity above which the crack will branch. Similar stress levels are found using 2 different fracture criteria: the Griffith energy criterion and the criterion of critical shear strain averaged over a critical area. (Contractor's abstract)

1320

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

A NON-CATALYTIC SURFACE FOR DISSOCIATED COMBUSTION GASES, by J. C. Cutting, J. A. Fay and others. [1959] [6]p. incl. diagrs. refs. (AFOSR-612) (AF 49(636)375) Unclassified

Also published in Proc. Conf. on Phys. Chem. in Aerodynam. and Space Flight, Pennsylvania U., Philadelphia, New York, Pergamon Press, 1961, p. 53-60. (AFOSR-TR-60-105)

Also published in Planetary and Space Sci., v. 3: 53-60, Feb. 1960.

The total heat transfer to a small diameter wire placed normal to a shock-tube axis was measured by determining the change in electrical resistance of the wire. The heat transfer to coated and uncoated wires were compared to determine the relative effects of various surface coatings. It was concluded that both the bare and coated surfaces are noncatalytic to the recombination of $2\,CO + 1/2\,H_2 + H \rightarrow CO + H_2O + C_{(s)}$ while the coated wire is noncatalytic to H atom recombination. At 1 atm pressure the boundary layer was nearly at equilibrium, and the noncatalytic coating of the wall had little effect in reducing heat transfer. At the lowest pressure, the boundary layer should be frozen and a marked reduction due to the noncatalytic wall was found.

1321

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

THE RESPONSE OF LINEAR SYSTEMS TO NON-GAUSSIAN RANDOM INPUTS, by S. H. Crandall, W. H. Siebert, and B. P. Hoguetis. [1960] [2]p. incl. diagrs. (AF 49(638)564) Unclassified

Published in Jour. Aero/Space Sci., v. 27: 154-155, Feb. 1960.

Mazelsky's (Jour. Aeronaut. Sci., v. 21: 145-153, Mar. 1954) results are shown not to be valid in general. The counterexample given shows that it cannot be true in general that filtering favors the Gaussian distribution.

1322

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

INTERACTIONS AMONG BURNING FUEL DROPLETS. I. A SINGLE FUEL PLATE, by T.-Y. Toong. May 31, 1960 [26]p. incl. diagrs. (Technical rept. no. 6227-1) (AFOSR-TN-60-516) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(636)629 and Shell Oil Co.) AD 239513; PB 149461 Unclassified

The boundary-layer equations governing the flow of an oxidizer over a flat plate covered with fuel are solved for a special case, where the flame front can be treated as a discontinuity. The results presented include the profiles of velocity, composition and temperature in the boundary layer adjacent to the fuel plate as well as the evaporation or sublimation rate at the fuel surface and the combustion rate at the flame front. For a given fuel-oxidizer combination and for a given heat transfer required to evaporate (or sublime) one unit mass of fuel, both the evaporation (or sublimation) and the combustion rates per unit plate area and per unit mass velocity of the oxidizer in the free stream are inversely proportional to the square root of the length Reynolds number.

With increasing values of the heat ratio, they both increase at a given length Reynolds number, although the ratio of the combustion to evaporation (or sublimation) rates decreases. This latter observation indicates the possibility of a long over-ventilated flame near the wake of a burning fuel droplet. (Contractor's abstract, modified)

1323

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

INTERACTIONS AMONG BURNING FUEL DROPLETS. II. TWO PARALLEL FUEL PLATES, by T.-Y. Toong. May 31, 1960 [20]p. incl. diagrs. (Technical rept. no. 8227-2) (AFOSR-TN-60-517) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)629 and Shell Oil Co.) AD 239669; PB 149462 Unclassified

The interactions between two parallel fuel plates burning in an oxidizer stream are studied by means of an integral method. Where the flames adjacent to the plates are separated from each other, the evaporation or sublimation rate at the fuel surface increases with decreasing spaces between the plates. In the meanwhile, the combustion rate at the flame front decreases. These interactions become less important with decreasing value of the heat ratio. (Contractor's abstract, modified)

1324

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

A THEORETICAL STUDY OF INTERACTIONS BETWEEN TWO PARALLEL BURNING FUEL PLATES, by T.-Y. Toong. [1960] [7]p. incl. diagrs. (AFOSR-1660) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)629 and Shell Oil Co.) Unclassified

Also published in Combustion and Flame, v. 5: 221-227, Sept. 1961.

In a summary of 2 technical reports (item nos. 1322 and 1323, Vol. IV) a discussion is given on the basic causes and mechanisms of the interactions among burning fuel droplets and their effects on the performance of a combustor employing fuel sprays, with respect to both overall burning rate and combustion roughness and stability. An integral method is used to study the interactions between 2 parallel fuel plates burning in an oxidizer stream. It is shown that the evaporation or sublimation rate at the fuel surface increases with decreasing spacing between the plates, while the combustion rate at the flame front decreases. The importance of these interactions becomes less as the value of the heat ratio decreases.

1325

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

HIGH-HEAT-FLUX EFFECTS IN WIRE HEAT GAGES, by J. C. Cutting and J. A. Fay. [1960] [2]p. incl. diagr. (AF 49(638)643) Unclassified

Published in Jour. Aero/Space Sci., v. 28: 342-343, Apr. 1961.

Voltage-time responses were utilized to calculate the heat transfer rate to platinum wire by using Ohm's law and the temperature coefficient of resistivity. The most notable factor in these investigations is a very large temperature gradient established in the wire probe due to heat fluxes of the order 100 kw/cm^2. For platinum, this results in a temperature gradient of 2 x 10^5° K/cm. It is, therefore, expected that Ohm's law breaks down in regions of extremely high-temperature gradients perpendicular to the current flow.

1326

Massachusetts Inst. of Tech. [Dept. of Physics] Cambridge.

NEUTRON AND X-RAY DIFFRACTION STUDIES OF SOLIDS, by C. G. Shull. Final rept. Jan. 1, 1960 [35]p. incl. illus. diagrs. (Technical rept. no. 5) (AFOSR-TR-60-111) (In cooperation with Brookhaven National Lab., Upton, N. Y.) (AF 18(603)84) AD 245613 Unclassified

The design characteristics of the three neutron diffraction spectrometers (single crystal analysis, polycrystalline specimen, and polarized beam units) which have been constructed are discussed. Research activities included studies on the structure of Fe_3Al, LiOH, and $Ag(NO_3)$ in addition to intensity and resolution studies on the spectrometers.

1327

Massachusetts Inst. of Tech. Dept. of Physics, Cambridge.

HARTREE-FOCK CALCULATIONS FOR Mn^{++} IN CUBIC FIELDS, by R. E. Watson. [1959] [6]p. incl. diagrs. tables. (Sponsored jointly by Air Force [Office of Scientific Research under AF 18(603)84, Office of Naval Research, and Signal Corps]) Unclassified

Published in Phys. Rev., v. 117: 742-747, Feb. 1, 1960.

Hartree-Fock calculations have been carried out for the Mn^{++} ion in cubic fields produced by sets of octahedrally placed point charges. The two types of cubic 3d electrons were allowed to have different radial dependence. Results indicate that accurate predictions of the optical

absorption spectra require the investigation of the added contributions to the parameters (one- and two-electron integrals). (Contractor's abstract, modified)

1328

Massachusetts Inst. of Tech. [Dept. of Physics] Cambridge.

IRON SERIES HARTREE-FOCK CALCULATIONS, by R. E. Watson. [1959] [7]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force [Office of Scientific Research under AF 18(603)84, Office of Naval Research, and Signal Corps]) Unclassified

Published in Phys. Rev., v. 118: 1036-1045, May 15, 1960.

Seventy-six Hartree-Fock calculations have been completed for the iron series (Sc to Cu) atoms and ions. All calculations are for the $(3d)^n$ type configuration. Comparisons are made with the experimental ionization and multiplet spectra. Agreement is poor due to limitations in the Hartree-Fock formalism. The results are used in an effort to gain information concerning correlation energies. (Contractor's abstract)

1329

Massachusetts Inst. of Tech. [Dept. of Physics] Cambridge.

EFFECT OF CRYSTALLINE FIELDS ON CHARGE DENSITIES AND MAGNETIC FORM FACTORS, by A. J. Freeman and R. E. Watson. [1959] [5]p. incl. diagrs. refs. (Sponsored jointly by Air Force [Office of Scientific Research under AF 18(603)84, Office of Naval Research, and Signal Corps]) Unclassified

Presented at Proc. of the Fifth Symposium on Magnetism and Magnetic Materials, Nov. 16-19, 1959.

Published in Jour. Appl. Phys., v. 31, Suppl.: 374S-375S, May 1960. (Title varies)

Published in Phys. Rev., v. 118: 1168-1172, June 1, 1960.

Crystalline field has two effects on the free ion 3d wave functions and their form factors: (1) a differentiation or "splitting" of the two types of cubic 3d functions by an expansion of the $t_{2g}(e_g)$ orbitals and a contraction of the $e_g(t_{2g})$ orbitals resulting in two different radial charge densities, and (2) a net expansion of the charge distribution of the free ion value. The magnetic form factors due to this splitting effect when calculated according to the methods of Weiss and Freeman show deviations from free atom results. A form factor for Mn^{+2} shows a large expansion of the 3d charge density in agreement with results obtained by Hastings, Elliott, and Corliss. This agreement indicates that the well known discrepancy between theoretical and experimental values of these integrals arises from the fact that the quantities obtained experimentally are not true $F^k(3d, 3d)$ integrals. (Contractor's abstract)

1330

Massachusetts Inst. of Tech. Dept. of Physics, Cambridge.

THE THERMODYNAMICS OF PHASE EQUILIBRIUM, by L. Tisza. Feb. 26, 1960, 92p. incl. diagrs. table, refs. (Technical rept. no. 360) (AFOSR-TN-60-23) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108; and Air Force Office of Scientific Research under AF 49(638)95) AD 256974 Unclassified

Also published in Ann. Phys., v. 13: 1-92, Apr. 1961.

This is the first in a series in which thermodynamics is developed beyond its usual scope from a new postulational basis. The Gibbsian thermodynamics of phase equilibrium is distinguished from the thermodynamics of Clausius and Kelvin. The latter was put into an axiomatic form by Carathéodory, the present paper attempts a similar task for the Gibbs theory. The formulation of this theory as an autonomous logical structure reveals characteristic aspects that were not evident until 2 logical structures were differentiated. The analysis of the basic assumptions of the Gibbs theory allows the identification and removal of defects that marred the classical formulation. In the new theory thermodynamic systems are defined as conjunctions of spatially disjoint volume elements (subsystems), each of which is characterized by a set of additive conserved quantities (invariants); the internal energy, and the mole numbers of the independent chemical components. For the basic theory, it is convenient to assume the absence of elastic, electric, and magnetic effects. This restriction enables the definition of the thermodynamic processes as transfers of additive invariants between subsystems. Following Gibbs, it is postulated that all thermostatic properties of system are contained in a fundamental equation representing the entropy as a function of the additive invariants.

1331

Massachusetts Inst. of Tech. Dynamic Analysis and Control Lab., Cambridge.

FRICTION DRAG ON BLADED DISCS IN HOUSINGS AS A FUNCTION OF REYNOLDS NUMBER, AXIAL AND RADIAL CLEARANCE AND BLADE ASPECT RATIO AND SOLIDITY, by R. W. Mann and C. H. Marston. Dec. 31, 1959 [13]p. incl. illus. diagrs. table. (Rept. no. 124) (AFOSR-TR-60-95) (AF 49(638)289) AD 244482 Unclassified

Presented at ASME-EIC Hydraulic Conf., Montreal (Canada), May 7-19, 1961.

Also published in Jour. Basic Eng., v. 83: 719-723, Dec. 1961.

Extra losses from partial admission operation of a gas turbine occur both in the nozzle flow arc and away from

it. The latter have been related to the theory of fluid flow over a rotating disc expressing a dimensionless moment coefficient as a function of Reynolds number. By direct measurements of drag torque, the moment coefficient has been determined over a range of Reynolds number from 2.0×10^4 to 4.5×10^6 for several aspect ratios, axial and radial shroud clearances, and solidities. Losses increase with increasing aspect ratio. Small increases from minimum practical clearance have little effect, but blade pumping losses become severe at radial and axial clearances of the order of half the disc radius. Typical changes in solidity have only small effects on losses. (Contractor's abstract)

1332

Massachusetts Inst. of Tech. [Fluid Dynamics Research Group] Cambridge.

IMPULSIVE LOADING OF RIGID-PLASTIC CURVED BEAMS WITH AXIAL CONSTRAINTS, by M. M. Chen, P. T. Hsu, and T. H. H. Pian. [1960] [27]p. (AFOSR-316) (AF 49(638)160) AD 253292; PB 155340 Unclassified

The problem of the deformation of a rigid-plastic curved beam with axial constraints under given impulsive loading is considered. The governing equations for various phases of motion are formulated. The nonlinear differential equations are then solved by a numerical integration process for different values of loading. The results are compared with the case of a straight beam previously treated by Symonds and Mentel.

1333

Massachusetts Inst. of Tech. [Fluid Dynamics Research Group] Cambridge.

PRANDTL-MEYER EXPANSION IN EQUILIBRIUM AIR, by H. Kennet. [1960] [2]p. (AF 49(638)160) Unclassified

Published in ARS Jour., v. 30: 288-289, Mar. 1960.

Prandtl-Meyer flow for air in dissociative equilibrium occurs in hypersonic flow and in rocket engine nozzle flow. It is shown that by using simple approximations a closed form expression can be obtained, relating the pressure to the angle of turn.

1334

Massachusetts Inst. of Tech. Fluid Dynamics Research Group, Cambridge.

THEORY OF FLAME-FRONT STABILITY, by W. Eckhaus. [1960] [21]p. (AF 49(638)160) Unclassified

Published in Jour. Fluid Mech., v. 10: 80-100, Feb. 1961.

By use of a simplified model of a flame structure, and the assumption that the flame thickness is small compared with the wavelength of disturbances, a formula for the perturbation of the flame propagation velocity is derived. The flame velocity is shown to depend on the curvature of the flame, and on the rates of change of fluid velocities at the flame boundary. From stability analysis it then follows that properties of the mixture, as expressed in terms of the coefficient of heat conductivity and various coefficients of diffusion, play an important role in determining the stability picture. For some estimated values of these parameters the theoretical results are shown to agree with the general trend of the experimentally observed behavior. (Contractor's abstract)

1335

Massachusetts Inst. of Tech. Fluid Dynamics Research Group, Cambridge.

THE VIRTUAL MASS OF CLUSTERED BOOSTERS, by H. Ashley and G. W. Asher. Dec. 1960 [7]p. incl. diagrs. tables. (Rept. no. 60-7) [AF 49(638)160] Unclassified

Presented at Twenty-ninth annual meeting of the Inst. Aero/Space Sci., New York, Jan. 23-25, 1961.

Published in ARS Jour., v. 31: 757-763, June 1961.

Two complementary theories for unsteady flow over arrays of cylinders are presented. The first deals approximately with an infinite row of equally-spaced elements and provides limiting information on the influences of number and separation. The second involves systematic adaptation of the method of multiple imaged doublets. Considerable simplification is achieved through use of residues for calculating the fluid momentum. The application to a pair of cylinders is presented. It is shown that the method is capable of systematization of a high-speed computer to determine the virtual masses for a rather general, finite aggregate of elements executing arbitrary translational motions. By measuring frequencies of oscillation in air and water the virtual mass is found for a pair of cylinders, suspended by springs so as to translate either parallel or normal to the line between their centers. (Contractor's abstract, modified)

1336

Massachusetts Inst. of Tech. Fluid Dynamics Research [Group] Cambridge.

HYPERSONIC FLOW PAST BLUNT BODIES AT SMALL ANGLES OF ATTACK, by G. L. Gross. Oct. 1960, 55p. incl. diagrs. tables, refs. (MIT Fluid Dynamics Research [Group] rept. no. 60-4) (AFOSR-TN-60-1195) (AF 49(638)207) AD 247589; PB 153420 Unclassified

An analytical solution is derived for the flow in the nose region of blunt bodies of revolution with conic section profiles, traveling at hypersonic velocities and zero or small angles of attack. The approach chosen is that of linearization of the inviscid equations of motion in the angle of attack and the ratio of the density before to that behind the strong bow shock according to the modified Newtonian approximation. The density is assumed constant for the flow between shock and body surface. The possibility is discussed of a numerical extension into the neighborhood of Freeman's singularity, which does, however, not occur within finite distance from the axis for a paraboloid nose shape. (Contractor's abstract)

1337

Massachusetts Inst. of Tech. Fluid Dynamics Research Group, Cambridge.

INTERACTION OF OBLIQUE SHOCK WAVES WITH LAMINAR BOUNDARY LAYERS, by I. Greber. Apr. 28, 1959 [194]p. incl. illus. diagrs. refs. [MIT Fluid Dynamics Research Group rept. no. 59-2] (AFOSR-TR-60-62) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)207, National Aeronautics and Space Administration under NAw-6320, NAw-6412, NAw-6462, NAw-6507, and NAw-6523, and Northrop Aircraft Inc.) Unclassified

The interaction of oblique shock waves with initially laminar boundary layers is studied both experimentally and theoretically. The adverse pressure gradient due to a shock wave causes the wall shear stress to decrease upstream of the shock wave. When the pressure reaches a certain threshold the wall shear stress is brought to zero. For larger pressure rises a separated region occurs. When the separated flow region is sufficiently long, the pressure levels associated with separation depend only on local conditions. In comparison with the flat plate results, convex surface curvature reduces the pressure rises characteristic of separation, but increases the strength of the incident required to separate a laminar boundary layer. The decrease of the characteristic separation pressures is equivalent to a superposition of the pressure fields due to the body alone and due to the boundary layer. In comparison with solid wall results, the suction increases the pressure levels characteristic of separation, but increases the strength of the incident shock required to separate a laminar boundary layer. Convex surface curvature and suction tend to decrease the length of the separated region. (Contractor's abstract)

1338

Massachusetts Inst. of Tech. [Fluid Dynamics Research Group] Cambridge.

THE EFFECT OF MOLECULE RECAPTURE ON OSCILLATORY FREE MOLECULE FLOW, by S. [S.] Abarbanel. [1960] [14]p. incl. diagrs. (AFOSR-694) [AF 49(638)207] Unclassified

Published in Rarefied Gas Dynamics; Proc. Second Internat'l. Symposium, California U., Berkeley, [Aug. 3-6, 1960] New York, Academic Press, 1961, p. 231-244.

The problem of a flat disc undergoing simple harmonic motion normal to its own plane in a very rarefied gas is studied, for the condition that the max plate velocity is small compared to the most probable molecular speed. It is shown that one of the effects of molecular "recapture," wherein the plate catches up with slower moving molecules emitted from it, is to produce a cooling of the plate at the beginning of its oscillation. It is also shown that to first order this cooling effect is independent of the average "sitting time" of a molecule on the surface before reemission. It is concluded that the sitting time might not be deducible from an oscillating plate experiment even when its interpretation is based on a second order theory. (Contractor's abstract)

1339

Massachusetts Inst. of Tech. [Fluid Dynamics Research Group] Cambridge.

RADIATIVE HEAT TRANSFER IN FREE-MOLECULE FLOW, by S. [S.] Abarbanel. [1960] [9]p. incl. diagrs. table. (AFOSR-861) [AF 49(638)207] Unclassified

Also published in Jour. Aero/Space Sci., v. 28: 299-307, Apr. 1961.

The effects of thermal radiation on the equilibrium temperature on the surface of a body in free molecular flow are considered. Neglecting the thermal convection, the nondimensional temperature distributions for both zero and finite thermal conductivity are first formulated. Approximately for flight in terrestrial atmosphere and for hypersonic flow, they may then be simplified to an algebraic equation. When solar radiation and finite conductivity are included, the problem may be similarly formulated. The thermal distributions are then approximated and solved by graphical means.

1340

Massachusetts Inst. of Tech. [Fluid Dynamics Research Group] Cambridge.

TIME DEPENDENT TEMPERATURE DISTRIBUTION IN RADIATING SOLIDS, by S. S. Abarbanel. [1960] [12]p. (AFOSR-862) [AF 49(638)207] Unclassified

Also published in Jour. Math. and Phys., v. 39: 246-257, Dec. 1960.

Series solutions are provided for 1 dimensional heat conclusion problems with radiation to and from the boundaries of uniform-property conducting solid. Cases considered are: the semi-infinite solid, the finite-thickness slab, the sphere, and the spherical shell. For each geometrical configuration the case of gray-body radiation into vacuum and the effect of back radiation are

considered in order. The temperature distribution is known to be given through a Duhamel integral, in terms of the surface temperature. It is shown that the surface temperature satisfies a singular non-linear integral equation of the second Volterra type whose kernel depends upon the particular geometrical configuration in question. Explicit asymptotic solutions for short and long time are found for all cases. In addition, an exact solution for the semi-infinite body is given as the limit of a successive approximation procedure.

1341

Massachusetts Inst. of Tech. Fluid Dynamics Research Group, Cambridge.

ON THE THEORY OF TRANSONIC AILERON BUZZ, by W. Eckhaus. Dec. 1960 [59]p. (Rept. no. 60-6) (AFOSR-229) (AF 49(638)933) AD 252357; PB 155281 Unclassified

The developed nonviscous theory is applied to the problem of transonic aileron buzz for an airfoil at zero angle of attack. Two mechanisms which could possibly yield an explanation for the occurrence of aileron buzz are considered: (1) shock induced separation of the boundary layer from the airfoil and (2) interaction of the pressure field created by the aileron with the shock wave, outside the boundary layer. A procedure is developed to establish which of the 2 mechanisms is dominant in the occurrence of aileron buzz. All viscous effects are neglected and the actual flow is replaced by a simplified model. The solution for very low frequencies is obtained in the form of a series. Numerical results for the first approximation are presented, and a stability boundary for the onset of the buzz is obtained.

1342

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

MAGNETIC CERAMICS: VI. EVALUATION OF SOME METHOD OF NICKEL FERRITE FORMATION, by G. Economos. [1959] [5]p. incl. diagrs. refs. (Technical rept. no. 129) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-184110]) Unclassified

Presented at the Sixtieth annual meeting of the Amer. Ceram. Soc., Pittsburgh, Pa., Apr. 29, 1958.

Also published in Jour. Amer. Ceram. Soc., v. 42: 628-632, Dec. 1959.

The extent of nickel ferrite formation, as affected by 4 preparatory techniques, was investigated by determining the magnetic moment of the reacted powder with a vibrating-coil magnetometer. The oxide, carbonate, hydroxide, and oxalate methods were used. At low temperatures the hydroxide and oxalate techniques were found to give the greatest yield of ferro-spinel. The hydroxide method yielded a magnetic material by precipitation. Weight-loss measurements were correlated to the magnetic data. (Contractor's abstract)

1343

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

TRANSFER OF ELECTRIC CHARGES THROUGH RUTILE SINGLE CRYSTALS, by K. G. Srivastava. June 1959, 17p. incl. illus. diagrs. table. (Technical rept. no. 139) (Sponsored jointly by [Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-184110] and Atomic Energy Commission) AD 219993 Unclassified

Also published in Phys. Rev., v. 119: 520-524, July 15, 1960.

Electron transfer and onset of field emission was investigated in TiO_2 single crystals with dc current-time characteristics parallel and perpendicular to the optic axis as function of voltage, temperature, electrode material, and light absorption. The currents are much larger and field emission sets in at lower voltage when the field is parallel to the optic axis. Higher temperature favors the current transfer by increasing the carrier mobility. The effect of different electrode materials proved minor, except in the case of Ti, which as cathode raised the current by about 1 order of magnitude. Photoelectric measurements showed that, in the critical voltage region of incipient field emission, light absorption can apparently force the current reversibly into the field-emitting stage. (Contractor's abstract)

1344

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

A REFINEMENT OF THE DICKITE STRUCTURE AND SOME REMARKS ON POLYMORPHISM IN KAOLIN MINERALS, by R. E. Newnham. Apr. 1960, 30p. incl. illus. tables. (Technical rept. no. 148) (In cooperation with Cambridge U. (Gt. Brit.)) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-184110) AD 236323 Unclassified

The crystal structure of the clay mineral dickite ($Al_2Si_2H_4O_9$) is refined to a greater accuracy than that reported in an earlier analysis. The refinement was carried out with zero-layer intensity data collected about [100] and [110] using MoKα radiation. Coordinates obtained after 10 cycles of $F_o - F_c$) difference syntheses gave an R factor of 7.5% for 420 observed reflections. Improved lattice parameters, a = 5.150 ± 0.001, b = 8.940 ± 0.001, c = 14.424 ± 0.002A, β = 96°44' ± 1', were determined by graphical extrapolation from single-crystal diffraction spectra near θ = 90°. The dickite

structure shows several significant distortions from the geometry of the idealized kaolin layer, including deformation and rotation of the silica tetrahedra. The most striking features of the octahedral layer are the extremely short shared edges of 2.37A. A model consistent with the infrared absorption spectra is proposed. The stacking sequences of kaolin-layer minerals have been considered with reference to the structural features observed in dickite. There are 36 ways of superposing 2 kaolin layers commensurate with the O-H — O bonds found in kaolinite, dickite, and nacrite. The 12 sequences showing the least amount of cation-cation superposition between consecutive kaolin layers can be used to construct 2 one-layer cells, kaolinite and its mirror image, and 12 two-layer cells, including dickite and nacrite. The distortions of the kaolin layer introduce secondary variations in the interlayer bonding which suggest that dickite and nacrite are the most stable of the kaolin-layer structures, since they possess the shortest oxygen-hydroxyl contacts. (Contractor's abstract)

1345

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

PRESSURE DEPENDENCE OF THE NEEL TEMPERATURE IN CoO and NiO, MEASURED WITH A NEW DILATOMETER, by T. P. Janusz. Apr. 1960, 31p. incl. illus. table, refs. (Technical rept. no. 150) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-184110) AD 237059 Unclassified

A high-pressure dilatometer employing a gaseous pressure medium is developed to measure, over a range of pressures and temperatures, the change in sample length that occurs in many solid-state phase transformations. The device employs a differential transformer as length detector. The system at present covers a temperature range of -40° - +275°C and a pressure range up to 10^4 atm. With a low-temperature cryostat the temperature range may be extended downward. As an application of the new device, the pressure dependence of the Neel temperature was measured for CoO $[(dT_N/dP) = (0.63 \pm 0.1) \times 10^{-3}$ deg/atm] and NiO$[dT_N/dP) < 2 \times 10^{-3}$ deg/atm]. (Contractor's abstract)

1346

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

SOME DEVELOPMENTS IN HIGH-PRESSURE TECHNIQUE, by P. W. Forsbergh, Jr. June 1960, 39p. incl. illus. (Technical rept. no. 151) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-184110) AD 238164 Unclassified

Various research problems requiring high-pressure techniques are investigated. Consideration is given to solids and gases as pressure media, typical metals used in high-pressure design and methods of making seals (hydraulic and electrically insulating seals). Examples of high-pressure design are presented which include 2-dimensional pressure holders, precompressors, systems with lapped quartz seals, systems with optically flat quartz seals, systems with hydraulically loaded closures, and systems with hydraulically loaded piston gaskets. The measurement of pressure, length, and lattice parameters is discussed.

1347

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

FORMATION OF Fe^{4+} IN THE SYSTEM $LaFeO_3$-$SrFeO_3$, by J. S. Waugh. Aug. 1960, 35p. incl. illus. tables, refs. (Technical rept. no. 152) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-184110) AD 241520 Unclassified

The presence of tetravalent iron in the system $LaFeO_3$-$SrFeO_3$ was demonstrated by measurements of the electrical conductivity, thermoelectric voltage, optical absorption, magnetization, and by chemical analysis. $LaFeO_3$, an antiferromagnetic, has a conductivity of 10^{-5} ohm^{-1}-cm^{-1} at room temperature and acts as a semiconductor with an activation energy of 0.3 ev. Mixed crystals containing La^{3+} and Sr^{2+} ions are good semiconductors with conductivities ranging as high as 10^2 ohm^{-1}-cm^{-1} at the composition $(La_{0.5}Sr_{0.5})FeO_3$. The activation energy decreases from 0.3 ev for $LaFeO_3$ to 0.03 ev for $SrFeO_3$. The conductivity, magnetization, and optical absorption exhibit a maximum at the equimolar composition $[(La_{0.5}Sr_{0.5})FeO_3]$. The thermoelectric voltage changes sign at this composition from positive in the $LaFeO_3$-rich to negative in $SrFeO_3$-rich region. Chemical analysis shows that, as might be expected, $SrFeO_3$ is not stoichiometric when fired at 1 atm of oxygen pressure but is oxygen deficient (composition ~ $SrFeO_{2.75}$). (Contractor's abstract)

1348

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

TEMPERATURE AND THICKNESS DEPENDENCE OF THE ELECTRICAL BREAKDOWN STRENGTH OF ALKALI HALIDES, by L. R. Schissler. Sept. 1960, 20p.

incl. illus. refs. (Technical rept. no. 153) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-184110) AD 245066 Unclassified

Equipment has been built to measure the breakdown strength of crystals with dc or impulses ranging from 100 to 0.03 μsec rise time over the range from -150°-500°C. The breakdown strength of potassium bromide and lithium fluoride was measured from -150°C - 100°C using 1-μsec impulses, and at room temperature with dc voltages. Evaporated film electrodes were used. An increase in breakdown strength occurred for thin samples of KBr when tellurium diffuse-edge cathodes and gold anodes were used. The breakdown strength was about twice as high for 20-μ than for 100-μ samples. This effect persisted at 100° but was much reduced at -150°C. Dc tests on KBr with Te anodes and Au cathodes showed practically no thickness effect. In LiF, no thickness effect was observable over the range 15-40μ, possibly because of the large scatter in the results. The highest breakdown strength found for KBr was about 1.1 mv/cm (26°C, 20 μ thick). Values for thicker samples were about 0.55 mv/cm. The highest breakdown strength observed in LiF was about 3.3 mv/cm. (Contractor's abstract)

1349

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

CONDUCTIVITY IN IRON OXIDES, by D. S. Tannhauser. Oct. 1960, 26p. incl. illus. (Technical rept. no. 154) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-184110) AD 245067 Unclassified

The conductivity and thermal emf of wüstite and magnetite have been measured as a function of the ratio O/Fe at T ≥ 1000°C. The conductivity, which shows only a very small temperature dependence, changes slightly on crossing the wüstite-to-magnetic phase boundary but decreases rapidly in both phases as the composition approaches stoichiometric FeO and Fe_2O_3, respectively. The thermal emf is p type in wüstite of low oxygen content, it changes to n type at high oxygen content and stays n type in magnetite. The results are explained in terms of an electron-transfer model. Such a model predicts a conductivity proportional to the concentration of divalent iron times the concentration of trivalent iron, and the experimental values fit such a relationship. A band model, on the other hand, needs a number of rather arbitrary assumptions to explain the results. Some measurements on hematite indicate that this phase is very narrow and that electron transfer between iron ions of different valency plays only a minor role in this substance. (Contractor's abstract)

1350

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

A TORQUE MAGNETOMETER FOR CRYSTALLINE ANISOTROPY MEASUREMENTS, by R. P. Hunt. Oct. 1960, 31p. incl. illus. tables. (Technical rept. no. 155) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-184110) AD 248184 Unclassified

An instrument designed to measure the torque of magnetic samples automatically and continuously as a function of the angle of an applied magnetic field with respect to the sample is described in detail. General operation of the equipment is outlined, and the system is analyzed on the basis of feedback theory. Results of a temperature run on magnetite and yttrium iron garnet are shown, along with a room-temperature determination of the anisotropy of nickel. Measurements were also made on the induced anisotropy of polycrystalline yttrium iron garnet and associated relaxation phenomena. (Contractor's abstract)

1351

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

DISTORTABLE DOUBLE WELL. A PROTOTYPE FOR THE ANALYSIS OF RELAXATION SPECTRA, by R. Fuchs and A. von Hippel. Nov. 1960, 23p. incl. diagrs. refs. (Technical rept. no. 156) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-184110) AD 248185 Unclassified

Also published in Jour. Chem. Phys., v. 34: 2165-2173, June 1961.

The origin of dielectric relaxation spectra is frequency not the rotation of dipoles as visualized in the Debye and Onsager models but the reversible transfer of ions or electrons between equilibrium sites. The displacement of such charge carriers corresponds to a reversal of dipole moments and had been treated previously as a shifting of charges between fixed equal or unequal double wells. The reversal of dipole moments in condensed phases, however, frequently has decisive after effects: The electrical unbalance created leads to compensating action of the surroundings, lowering the free energy and tending to freeze in the charge in the occupied well site. Thus the double well becomes unequal because of the reaction of the embedding medium. This model of a distortable double well is here treated, first in its stationary state with and without superposed dc field and then its ac response, under the simplying assumption that the surroundings react by an exponentially decaying distortion described by a time constant and final well depth. The characteristics of the model are that it incorporates the equal and unequal fixed double well as special cases but in addition shows an inherent

distribution of relaxation times and — for long observation periods — an anomalously large polarizability, since eventually the wells can be turned with their deepened sites in the favorable field direction. (Contractor's abstract, modified)

1352

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

GROWTH OF CESIUM CHLORIDE CRYSTALS FROM SOLUTION AND MELT, by P. Avakian and A. Smakula. [1960] [3]p. incl. illus. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-184110]) Unclassified

Published in Jour. Appl. Phys., v. 31: 1720-1722, Oct. 1960.

Large cesium chloride crystals (~/cm^3 optically clear crystals) are obtained from solution only upon addition of urea. These crystals, however, show NH_4^+ impurity.

Since CsCl undergoes a phase transition between its melting point and room temperature, normal growing methods from the melt could not be used, but a modified ("double-run") Bridgman method yielded good results. (Contractor's abstract)

1353

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

COLORATION OF PURE AND DOPED CALCIUM FLUORIDE CRYSTALS AT 20°C AND -190°C, by W. J. Scouler and A. Smakula. [1960] [8]p. incl. illus. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-184110]) Unclassified

Published in Phys. Rev., v. 120: 1154-1161, Nov. 15, 1960.

Coloration of pure CaF_2 crystals with 2.5 mev electrons at room-temperature results in bands at 580, 400, 335, and 225 mμ. In YF_3-doped crystals the bands are in the same spectral positions as in pure crystals. They are, however, enhanced and their intensity ratios are significantly changed, the 400-mμ band being predominant. NaF-doped crystals show an even more drastic change: Coloration at room-temperature produces bands at 605, 385, and 330 mμ and is deeper than in either pure or YF_3-doped crystals. Since the 400-mμ band is strongly enhanced by YF_3 addition which forms F^- interstitials, it is correlated to neutral fluorine atoms in interstitial positions. Similarly, the 605-mμ band in crystals doped with NaF, which creates F^- vacancies is correlated to electrons trapped in F^- ion vacancies (F centers). The enhancement of the 385-mμ band by NaF is explained by the reduction of the activation energy required for formation of interstitials and vacancies. Of several possible correlations the 330-mμ band is probably connected with a hole trapped in a Ca^{2+} vacancy and that at 225 mμ with an electron trapped by a Ca^{2+} interstitial. The bands at 440 and 200 mμ which appear in NaF-doped crystals only must be connected with Na ions. Coloration at -190°C produces strong changes in the absorption spectrum. In pure and YF_3-doped crystals bands appear at 550, 320, and 270 mμ while in NaF-doped crystals bands are formed at 440, 390, 315, and 200 mμ in addition to the 550-mμ band. The primary process of coloration at low temperature cannot differ from that at room temperature but the secondary processes are strongly influenced by temperature. (Contractor's abstract)

1354

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

INTERACTION OF A POLARIZABLE POTASSIUM CHLORIDE CRYSTAL WITH A VALENCE-BAND HOLE, by S. J. Nettel. [1960] [11]p. incl. diagr. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-184110]) Unclassified

Published in Phys. Rev., v. 121: 425-435, Jan. 15, 1961.

The interaction of a valence-band hole with a potassium chloride crystal, when crystal-hole correlations are considered, is studied by variational means. Initially a crystal trial wave function is constructed which allows for the ionic polarizability of the crystal by means of a correlation between the crystal configuration and the motion of the hole. The expectation value of the Hamiltonian operator for the crystal is found by integrating over both electronic and nuclear coordinates. The necessary matrix elements of the electronic energy operators are taken from a previous calculation by Howland. The total energy expectation is minimized with respect to a single parameter in the wave function that measures the hole-lattice correlation. One finds that the valence bands obtained when the crystal lattice is treated as rigid become completely flat, a result which implies that the hole is self-trapped. The modifications that are introduced by the addition of the electronic polarizability are studied by repeating the previous calculation with a refined wave function. Only a rough treatment drawing on the experimental electronic polarizabilities of the crystal ions is given. Information on self-trapped holes in KCl derived from the electron-spin resonance experiments of Castner and Känzig is briefly considered. (Contractor's abstract)

1355

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

MAGNETIC RESONANCE IN CANTED FERRIMAGNETS, by P. A. Miles. [1960] [4]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [Nonr-184110]) Unclassified

Published in Phys. Rev., v. 122: 1143-1146, May 15, 1961.

The classical theory of the uniform (k = 0) modes for a 4-sublattice, planar canted ferrimagnet is developed. Two of these modes should be in the microwave range for reasonable values of applied field, anisotropy, and exchange constants: the normal low-frequency mode familiar in collinear ferrimagnets and the mode excited by longitudinal rf fields at a frequency depending on anisotropy and angle cant. Observation of this latter mode should allow analysis of ferrimagnetic structures and phase changes. (Contractor's abstract)

1356

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

THE CRYSTAL STRUCTURE OF $MoTe_2$, by D. Puotinen and R. E. Newnham. [1960] [2]p. incl. tables. (Sponsored jointly by Air Force Cambridge Research Center under AF 19(604)4153, Air Force [Office of Scientific Research], Office of Naval Research, and Signal Corps under Nonr-184110) Unclassified

Published in Acta Cryst., v. 14: 691-692, June 10, 1961.

The crystal structure of $MoTe_2$ as determined from its powder pattern, using a diffractometer and filtered CuKα radiation, is reported. In the $MoTe_2$ structure, each Mo is coordinated to a trigonal prism of 6 telluriums; the Mo-Te distance is 2.73A. Each Te is surrounded by 10 other tellurium atoms; 6 in the close-packed (00.1) plane at 3.52A, 1 directly below it at 3.63A, and 3 above it at 3.02A across the cleavage plane. The Te-Mo-Te bond angles are 83.5° (3), 80.4° (6), and 133.9° (6), in good agreement with the d^4sp hybrid bonds proposed by Hultgren. (Contractor's abstract)

1357

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

USE OF OXIDE-COATED CATHODES IN HIGH CURRENT ACCELERATORS, by G. Davidson, S. Ozaki, and R. Weinstein. [1959] [2]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Rev. Scient. Instr., v. 31: 31-32, Jan. 1960.

An investigation has been made of the possibility of using an oxide-coated cathode as an electron source for the M.I.T. 320-mev electron synchrotron. A button cathode originally designed by Sperry Gyroscope Co. is redesigned slightly to meet our specifications. With this new cathode, an average lifetime of 330 hr, operated at peak-pulsed current of 200 ma in vacuums as poor as about 10^{-5} mm Hg was obtained. This represents a factor of about 20 improvement in lifetime-current product over directly heated cathodes. (Contractor's abstract)

1358

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

A NOTE ON QUASI-ELASTIC PHOTON-DEUTERON SCATTERING, by P. [G.] Federbush. [1959] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Nuovo Cimento, Series X, v. 15: 479-480, Feb. 1, 1960.

By using simple perturbation theory, a scattering amplitude is obtained which approaches neither the deuteron Thomson limit nor the proton Thomson limit but even a larger value at low energy. The differential cross section with polarization averaged over assumes the form:

$$d\sigma_d = \left(\frac{1}{4}\right)^2 \cdot \frac{1}{2} \cdot (1 + \cos^2\theta)\left[\left(\frac{e^2}{M}\right)^2 + \right.$$

$$\frac{1}{2}\int \frac{d^3q}{(2\pi^3)} \int d^3x \varphi^2(x)\, \frac{e^2}{2M} \cdot$$

$$\left. \cdot\, 4\pi \cdot \frac{4}{3}\, e^2 f_r^2 \left[\frac{2 \exp i(q-k)\cdot x]}{k^2 - \omega^2}\right] \cdot \right.$$

$$\left.\left(1 - \frac{1}{3}\,\frac{q^2}{(q^2+u^2)^2} - \frac{q^2}{q^2+u^2}\right)\right], \text{ where } \omega^2 = q^2 + u^2;$$

θ = scattering angle, μ = meson mass, and $\varphi(x)$ deuteron wave function. Certain terms of order (k/μ) have been neglected, and a purely $l = 0$ wave function is assumed. Within these assumptions, the angular dependence is the same as that of the Thomson amplitude. If terms of the order $(k/\mu)^2$ are included and the Hulthén wave function is used, the result is an addition of about 15% to the Thomson cross section as well as a change in the angular distribution.

1359

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

AN APPROXIMATE LENS FOR HIGH ENERGY PARTICLES, by D. Luckey. [1959] [2]p. incl. illus. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Rev. Scient. Instr., v. 31: 202-203, Feb. 1960.

A description is given of a wire lens, composed of 19 conductors, for approximating the required uniform field density of a restoring force on a charged particle. The lens has operated at currents up to 10^3 amp (at a power of 38 kw). At 10^3 amp per conductor, the average gradient is ~46 gauss/cm. A comparison to the standard quadrupole lens is made.

1360

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

SOME PREDICTIONS FROM A COMPOSITE MODEL OF BARYONS, by D. H. Frisch. [1959] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Nuovo Cimento, Series X, v. 15: 757-759, Mar. 1, 1960.

Baryons are considered as composites of a neutral baryon core plus various mesons. This model makes 3 specific predictions: (1) The K^+-Σ^0(Λ^0) force should be more attractive than the K^--Σ^0(Λ^0) force. (2) Neutral particles should be approximately electrically neutral throughout. (3) At high energies many elementary particle reactions should be characteristic angular distributions. (Contractor's abstract)

1361

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

ENERGY AND ANGULAR DISTRIBUTION OF PROTONS FROM (α,ρ) REACTIONS (Abstract), by L. W. Swenson and N. Cindro. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 76, Jan. 27, 1960.

The results of proton energy spectra measurements at several angles from 30.5 mev alpha particle induced reactions on Al^{27}, V^{51}, As^{75}, Nb^{93}, Rh^{103}, In^{115}, and Ta^{131} were analyzed using the statistical model. The differential cross section and level density are also obtained. The spectra are characteristic of compound nuclear process with indication of direct reaction contribution at forward angles and low excitation. The nuclear $1/T = d(\ln\rho)/dE$ at two excitation energies and the parameter α of $\rho \sim \exp[\alpha E^{\frac{1}{2}}]$ of the residual nuclei determined from the 150° data are presented in the table.

Nucleus	W^{184}	Sn^{116}	Pd^{106}	Mo^{96}	Se^{78}	Ni^{62}	Cr^{54}	Si^{30}
T(11 mev)	1.26	1.7	2.0	1.9	1.9	1.8	2.0	2.3
T(5 mev)	0.8	1.8	1.0	1.15	1.15	1.2	1.35	1.4
α	26.0	15.6	12.8	15.5	15.5	11.2	11.2	7.2

The magic nucleus Sn^{118} shows higher temperature at low excitation. The spectra are adequately described by the above form of ρ at 150°. This provides a frame of reference from which the importance of the direct reaction contribution may be evaluated. Eisberg et al. find much lower values of α at 40 mev.

1362

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

HAAG'S THEOREM IN A FINITE VOLUME, by P. [G.] Federbush. [1960] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Nuovo Cimento, Series X, v. 15: 932-933, Mar. 16, 1960.

A comparison of the vacua of a free field theory and a coupled field theory is considered. It is known that if the overlap of 2 spatially homogeneous wave functions is not unity in a finite volume, the overlap will be zero in an infinite volume. It is shown that a postive result is suggested by extending Haag's theorem to a finite volume.

1363

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

MESONS AND THE STRUCTURE OF NUCLEONS. PART III. PION-NUCLEON SCATTERING, by G. Costa and B. T. Feld. [1960] [19]p. incl. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Ann. Phys., v. 9: 354-372, Mar. 1960.

The "atomic" model of the physical nucleons has been used in a direct computation of free pions by nucleons. The computation is analogous to the computation of the scattering of electrons by hydrogen atoms. Neglecting any pion-pion interaction, p-wave scattering phase shifts are computed, in the Born approximation and also by an improved technique, for various assumptions concerning the interaction between a pion and the nucleon "core". The model is shown to be capable of reproducing the resonant scattering in the (3,3) isobar state, while predicting much smaller wave shifts for the other states. Our results differ from the Chew-Low theory, in the Born approximation, only in that we predict a small, positive phase-shift for scattering in the (1,1) state; the experiments appear to favor our prediction. We conclude that the same pion-nucleon interaction, which accounts for the properties of the ground (physical) nucleon state, leads to the observed low-energy pion-nucleon scattering. (Contractor's abstract)

1364

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

STRIPPING ANALYSIS OF THE $V^{51}(d, p)V^{52}$ REACTION (Abstract), by H. A. Enge, W. W. Buechner, and J. H. Wojtaszek, Jr. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 249, Apr. 25, 1960.

The MIT-ONR Van de Graaff accelerator and broad-range spectrograph were used to study angular distributions of protons emitted from a V^{51} target bombarded with 7.5-mev deuterons. Some preliminary results of the stripping analysis are given. Levels at 0.530, 0.625, 0.723, 1.280, 1.484, 1.653, 1.827, 2.347, 2.412, 2.455, 2.563, 2.610, 2.630, and 2.823 mev do not show typical stripping distributions or are so weak that an l_n value could not be assigned. Seventeen additional levels up to 3.624-mev excitation will be reported.

1365

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

$Li^7(\alpha,p)Be^{10}$ AND $Li^6(\alpha,p)Be^9$ REACTIONS AT 30 MEV, by P. R. Klein, N. Cindro and others. [1960] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Nuclear Phys., v. 16: 375-376, May 1960.

Angular distributions for the $Li^7(\alpha,p)Be^{10}$ and $Li^6(\alpha,p)Be^9$ reactions were obtained for the ground state of the residual nucleus, using 30 mev α particles. In the case of the Li^7 reaction an angular distribution was obtained having the residual nucleus in the first excited state. Of particular interest in all 3 of these angular distributions is the sharp increase in differential cross section at back angles. It is shown that the present theories of direct reactions are inadequate to account for this structure. (Contractor's abstract)

1366

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

COULOMB EXCITATION OF BETA- AND GAMMA-VIBRATIONAL STATES IN Sm^{152}, by R. K. Sheline, H. L. Nielsen, and A. Sperduto. [1960] [11]p. incl. diagrs. tables, refs. (In cooperation with Florida State U., Tallahassee) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Nuclear Phys., v. 16: 518-528, May 1960.

A Sm^{152}-target made by electromagnetic isotope separation has been bombarded with 7.5-8.5 mev deuterons and 8.6 mev protons. Inelastic scatter groups corresponding to Coulomb excitation of the level at 122 kev have been observed in every case, and in 1 run with 8.5 mev deuterons Coulomb excitation of levels at 807 kev and 1079 kev has been seen. The reduced transition probabilities to these states are measured as 4.1 ± 0.1, 0.07 ± 0.02 and 0.12 ± 0.02, respectively, in units of $e^2 \times 10^{-48}$ cm^4. The reduced transition probabilities for the 2 highest excited states are several times the single particle values. This is a strong indication of the collective nature of both these states. Accordingly, these levels are interpreted as beta- and gamma-vibrational states. The partial lifetime and the nuclear strength parameter for the EO-transition between the 807 kev and the 122 kev levels have been calculated from the experimental data and are found to be in poor agreement with the theoretical values. (Contractor's abstract)

1367

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

LOW-ENERGY PHOTODISINTEGRATION OF H^3 AND He^3 AND NEUTRON-DEUTERON SCATTERING, by L. M. Delves. [1960] [5]p. incl. diagrs. table, refs.

(Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 118: 1318-1322, June 1, 1960.

The cross sections for electric dipole photodisintegration of H^3 and He^3 at low energies are expressed in terms of the effective range parameters of the doublet n-d scattering matrix. Agreement with the experimental results is possible for either set of n-d scattering lengths. (Contractor's abstract)

1368

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

GROUND-STATE Q VALUES FOR THE $Si^{30}(p,\alpha)Al^{27}$ AND $O^{16}(p,\alpha)N^{13}$ REACTIONS, by R. E. White and W. W. Buechner. [1960] [2]p. incl. tables. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 118: 1331-1332, June 1, 1960.

Alpha-particle groups observed during the magnetic analysis of charged particles produced in the bombardment of silicon-dioxide targets with 8- and 8.59-mev protons have been identified as arising from the reactions $Si^{30}(p,\alpha)Al^{27}$ and $O^{16}(p,\alpha)N^{13}$. The corresponding Q values are -2.366 ± 0.010 mev and -5.206 ± 0.010 mev, respectively. (Contractor's abstract)

1369

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

PARITY-NONCONSERVING INTERNUCLEON POTENTIALS, by F. J. Blin-Stoyle. [1960] [3]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 118: 1605-1607, June 15, 1960.

The general form that a parity-nonconserving internucleon potential must take because of invariance requirements is obtained. A detailed calculation is then made of the parity-nonconserving potential rising from a self-interacting current description of weak interactions. If the polar vector part of the current (J_μ^V) is conserved, then parity-nonconservation of the order 1 part in 10^7 ($\mathcal{R} \approx 10^{-7}$) is to be expected in nuclear processes. Failure to observe such an effect would indicate either that J_μ^V is not conserved or that the self-interacting current description is incorrect. (Contractor's abstract)

1370

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

CLASSICAL THEORY OF COMPOUND NUCLEUS REACTIONS, by T. Ericson. [1960] [14]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Nuclear Phys., v. 17: 250-263, June 1960.

The emission of particles from a compound system to individual states in the residual nucleus is studied in the classical limit of large angular momenta. Expressions are derived for total and differential cross-sections, when the target spin is polarized and unpolarized under different initial and final conditions. It is found that the angular distribution has a very simple classical limit, when the dependence on angular momentum of the penetrabilities of the emitted particle can be neglected.

1371

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

OBSERVATION OF A SHORT-LIVED COSMIC-RAY FLARE INCREASE WITH A HIGH-COUNTING-RATE MESON DETECTOR, by R. A. R. Palmeira and K. G. McCracken. [1960] [2]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098] and National Science Foundation) Unclassified

Published in Phys. Rev. Ltrs., v. 5: 15-16, July 1, 1960.

Observations are reported of a very abrupt and short-lived cosmic ray increase which was observed at M.I.T. on May 4, 1960 using 3 large meson telescopes, of total sensitive area 10 m^2 and total counting rate ≈ 900 counts sec^{-1}, recorded at coordinates 41°23'N, and 71°08'W. The most outstanding feature of the cosmic-ray effect is the very short time scale - the rising intensity and decaying intensity phases being much shorter than those observed during any previous case of this type event. The short time scale would be explained in terms of the earth being within an essentially radial field which was rooted in the active area of the sun. The very short time scale suggests that there would be relatively few irregularities in this field, consequently, the radiation arriving at the earth would be largely collimated along the lines of the field. This predicts that during the May 4 event (1) impact zones were very pronounced,

(2) there was little time dispersion between the high- and low-energy particles, and (3) the effect observed by stations outside the impact zones was relatively small.

1372

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

EXCITED STATES OF P^{32}, by D. Piraino, C. H. Paris, and W. W. Buechner. [1960] [4]p. incl. diagrs. table. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 119: 732-735, July 15, 1960.

The proton groups from the P^{31} (d,p) P^{32} reaction have been studied at angles of 30, 50, 70, and 90 degrees. The incident deuteron energy was 6 mev, and the protons were analyzed with a broad-range magnetic spectrograph. Fifty-two excited states were found in the region between the ground state and 6.2 mev in P^{32}.

1373

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

RESULTS OF STRIPPING ANALYSIS OF THE Co^{59}(d,p)Co^{60} REACTION, by H. A. Enge, D. L. Jarrell, and C. C. Angleman. [1960] [6]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 119: 735-740, July 15, 1960.

The MIT-ONR electrostatic generator and broad-range magnetic spectrograph have been used to investigate proton groups produced by bombarding thru cobalt targets with 6.0-mev deuterons. The angular distributions of the 28 most intense proton groups corresponding to as many levels in Co^{60} were analyzed in terms of stripping theory to determine the orbital angular momentum of the captured neutron. The Q values of the (d,p) reaction were measured for 60 levels of Co^{60}. The ground-state Q value was found to be 5.262 ± 0.011 mev.

1374

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

DECAY OF 6.3-MIN Br^{78}, by W. R. Pierson and C. D. Coryell. [1960] [6]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 119: 755-760, July 15, 1960.

The nuclide 6.3-min Br^{78} has been made by the reactions (γ,n), (n,2n), (p,n), (d,2n), and (α,n), and its decay properties have been investigated by positron decay-curve analysis by application of a standard chemical isomer-separation procedure, by searching for conversion electrons, and by studying the gamma-ray and positron-gamma-coincidence spectra. The early portion of the positron decay curve exhibited a single 6.25 ± 0.2-min component, and no active daughter of this species was chemically separable from active CBr_4.

Conversion electrons were not found, and soft gamma rays were shown to be absent. There are 12-kev x-rays, of intensity about 0.05 relative to the positrons and therefore presumed to be K x-rays of Se resulting from electron capture. These results show that 6.3-min Br^{78} has no daughter isomer and probably no > 10-sec parent isomer. There is a 615-kev gamma ray, in coincidence with positrons, and of intensity 0.139 that of all positrons, representing decay of Br^{78} to Se^{78} in the 615-kev 2 + state. However, no evidence for decay to Se^{78} in the 1.32-mev state could be found. From these data it was deduced that 6.3-min Br^{78} decays 81% by positron emission and 6% by electron capture to ground-state Se^{78}, 11% by positron emission and 2% by electron capture to Se^{78} in the 615-kev state, and < 1% to Se^{78} in the 1.32-mev state. The disintegrations of Br^{78} to Se^{78} in the ground state and 615-kev state have log ft values of 4.8 and 5.2, respectively, indicating that the spin of ground-state Br^{78} is 1, with even parity. The absence of isomerism is discussed in terms of the locations of expected energy levels, with reference to the known locations of these levels in Br^{80}. (Contractor's abstract)

1375

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

ENERGY LEVELS OF THE SILICON ISOTOPES FROM INELASTIC PROTON SCATTERING, by R. E. White. [1960] [5]p. incl. diagrs. tables, refs.

(Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098] Unclassified

Published in Phys. Rev., v. 119: 767-771, July 15, 1960.

Energy levels of the stable isotopes of silicon, Si^{28}, Si^{29}, and Si^{30}, up to 6.5-mev excitation have been investigated by studying the inelastic scattering of 7.5-mev to 8.5-mev protons from a thin silicon-dioxide target with a broad-range magnetic spectrograph. Several new levels are reported, and the significance of the Si^{28} results is discussed in regard to a previously proposed interpretation of the level spectrum.

1376

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

THE ANOMALOUS INELASTIC SCATTERING OF ALPHA PARTICLES, by M. Crut, D. R. Sweetman, and N. S. Wall. [1960] [29]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Nuclear Phys., v. 17: 655-683, July 1960.

A series of experiments establishing and identifying the properties of the so-called anomalous states in medium-weight nuclei are reviewed. These excitation energies for states are about 4 mev for nuclei with $Z \leq 29$ and in the range of 2-3 mev for nuclei with higher Z. From a combination of angular distribution and correlation data presented, and interpreted by means of inelastic diffraction scattering analysis, the anomalous states in several cases to be consistent with a 3- interpretation. This lends credence to their collective interpretation. The difficulties with such analyses are discussed, and experimental matters are gone into in some detail. (Contractor's abstract)

1377

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

ARRIVAL DIRECTIONS OF COSMIC-RAY AIR SHOWERS FROM THE EQUATORIAL SKY, by E. V. Chitnis, V. A. Sarabhai, and G. Clark. [1960] [7]p. incl. diagrs. table. (In cooperation with Physical Research Lab., Ahmedabad, India) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)-2098]) Unclassified

Published in Phys. Rev., v. 119: 1085-1091, Aug. 1, 1960.

The celestial arrival directions of over 100,000 showers with sizes greater than 10^5 particles have been determined by fast timing in observations at an altitude of 2034 m. The observations covered a band of declinations from -30° to + 50° with an angular resolution of 4°, and they extended a survey begun in an earlier experiment that covered the northern sky. As in the earlier experiment no significant deviation from isotropy was found. The atmospheric attenuation of the shower intensity was determined from the zenith angle distribution, and also from a comparison of the absolute shower intensity at 2034 m and at sea level. Within an experimental uncertainty of about 5%, both methods yield an exponential attenuation length consistent with the value of 107 g cm^{-2} previously found at sea level. The absolute intensity of showers with more than 10^5 particles at 2034 m was found to be $(1.11 \pm 0.30) \times 10^9$ cm^{-2} sec^{-1} sr^{-1}. (Contractor's abstract)

1378

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

EQUATION OF STATE OF A BOSE-EINSTEIN SYSTEM OF PARTICLES WITH ATTRACTIVE INTERACTIONS, by K. Huang. [1960] [14]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Also published in Phys. Rev., v. 119: 1129-1142, Aug. 15, 1960.

The equation of state in the grand canonical ensemble is calculated for a system of Bose-Einstein particles with hard-sphere repulsive interactions and weak long-range attractions. The energy levels used in this calculation are modified forms of those derived in an earlier paper (Phys. Rev., v. 115: 765-777, Aug. 15, 1959). The calculation is carried out in the limit of no interactions, and attention is focused on the thermodynamic phases of the system. It is shown that the gross features of the equation of state of He^4 are reproduced. There are the phases: gas, liquid I, and liquid II. The phase transition between gas and the two liquids are first order transitions. The transition terminates in a critical point. The transition between liquid I and liquid II is the Bose-Einstein condensation. Liquid II has a negative coefficient of thermal expansion. Across the transition between liquids I and II the specific heat is discontinuous in value. In the limit of no interactions, the critical point recedes towards zero temperature, zero pressure, and infinite volume.

1379

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

ELASTIC SCATTERING OF 13.5- AND 15-MEV

DEUTERONS BY NUCLEI, by N. Cindro and N. S. Wall. [1960] [5]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 119: 1340-1344, Aug. 15, 1960.

Fifteen-mev deuterons from the MIT cyclotron were elastically scattered by a number of elements, including Al, Ti, Fe, Cu, Ni, Rh, Pd, Sn (natural and monoisotropic), Ta, Au, and Pb. The angular distributions were measured in the MIT cyclotron 24-in. scattering chamber, by means of a NaI(Tl) scintillation detector. The crystal was thick enough to stop 15-mev deuterons but too thin to stop protons of the same energy, thus, permitting measurement of the (d,d) cross sections for light elements, where (d,p) reactions play an important role. The obtained distributions differ sharply from the Rutherford formula $\sigma_c^{\alpha} \csc^4(\theta/2)$; most of them, especially those for medium and lighter elements, show pronounced diffraction-like maxima and minima. The energy of the beam was degraded to 13.5 mev and the angular distributions for Ni, Sn (natural), and Au, showing the same general characteristics. (Contractor's abstract)

1380

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

EXPERIMENTAL DYNAMICS OF BUBBLE CHAMBER WINDOW FAILURES, by L. Guerriero, I. Pless and others. [1960] [2]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Rev. Scient. Instr., v. 31: 910-911, Aug. 1960.

The rate of pressure rise in a safety box positioned in front of the window of a scale-model propane bubble chamber and the velocity of glass fragments in the case of window failure were measured. The ratio of safety box to chamber volume was varied from 4:1 to 9:1, and window failures were induced by closing of a valve to the chamber and raising the temperature slightly. The pressure rise takes an interval on the order of 3 msec, a similar experiment performed with He gave a time rise on the order of 1 msec. The glass fragments were found to have a maximum velocity of 200 m/sec. It was decided that a pressurized safety box with a relief valve for pressure release in the event of window failure would be best for the 15-in. diam methyl iodide-propane bubble chamber under consideration.

1381

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

QUANTUM ELECTRODYNAMICS IN THE INFINITE ENERGY LIMIT, by K. Johnson. [1960] [17]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Ann. Phys., v. 10: 536-552, Aug. 1960.

The spectral form of the single particle Green's functions are derived for spin zero and spin one-half fields. The restrictions imposed on the spectral weight functions by the commutation relations and the kinematic coupling of the charged field to the electromagnetic field are studied. It is shown that they require extremely slow convergence of the infinite integrals over the weight functions. In fact, the commonly made assumptions of uniform convergence of all such integrals with respect to any parameter of interest would lead to a contradiction of the consistency of the theory. However, it is pointed out that reasonable solutions of the theory could exist with the requisite convergence properties. (Contractor's abstract)

1382

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

APPLICATION OF DISPERSION RELATIONS TO MESON-NUCLEON SCATTERING, by A. C. Finn. [1960] [17]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 119: 1786-1802, Sept. 1, 1960.

Relativistic nonforward scattering dispersion relations are used to obtain information about low-energy meson-nucleon scattering. It is determined which of the s-, p-, and d-wave phase shifts are predicted by dispersion theory. Charge independence is assumed. The form of the dispersion relations used is justified by relating the asymptotic energy dependence of the dispersion relation amplitudes to the assumption of a finite range of interaction and to the choice of a particular meson current and the usual equal time commutation relations. The relevance of the analytic properties of the scattering amplitude as a function of momentum transfer is discussed in connection with the partial wave expansion of the dispersion amplitudes. The contribution to the dispersion integrals from energies above the 33 resonance is estimated.

1383

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

Q-VALUES FROM CHARGED-PARTICLE REACTIONS, by W. W. Buechner. [1960] [13]p. incl. diagrs. table. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under (AT(30-1)2098)) Unclassified

Published in Proc. Internat'l. Conf. on Nuclidic Masses, McMaster U., Hamilton, Ont. (Canada) (Sept. 12-16, 1960), Toronto U. Press, 1960, p. 263-275.

The work done in the general area of charged-particle reactions is briefly reviewed and emphasis is placed on the standards established at M.I.T. in connection with calibration procedures. The Q-values for the region between calcium and zinc are reported on, and it is shown that except for the links between titanium and scandium and between chromium and vanadium, a large fraction of the nuclei between calcium and copper are connected by (d,p) and (p,α) Q-values. These values are in good agreement with the new mass table of Everling et al. However, the data does not support the view that there does not exist a large discrepancy between results of the nuclear-reaction data and mass-spectroscopic investigations. The results of the latter are usually lower for (d,p) reactions and higher for reactions involving the emission of an alpha particle. The exact cause of this disagreement is not established but areas of investigation which might lead to a resolution of the discrepancies are indicated.

1384

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

COMPARISON OF SOLAR COSMIC RAYS INJECTION INCLUDING JULY 17, 1959, AND MAY 4, 1960, by K. B. McCracken and R. A. R. Palmeira. [1960] [11]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098, and National Science Foundation) Unclassified

Published in Jour. Geophys. Research, v. 65: 2673-2685, Sept. 1960.

Using neutron monitor data obtained at high latitudes, it is shown that cosmic-ray particles of rigidity > 1 bv were produced by the solar flare that occurred at 2115 UT of July 16, 1959. The exponent of the integral rigidity spectrum of the radiation was ≤ -8.0. The temporal dependence of the flare radiation was unlike that of earlier flare effects, the intensity requiring ~7 hr to reach its maximum value. No impact zones were observed. Meson data obtained at the time of the flare effect starting at 1031 UT on May 4, 1960 are also presented. It is shown that the time scale of the cosmic-ray effect is a highly variable quantity, varying by a factor as great as 36 from event to event. The flares responsible for the 4 flare effects with the shortest time scales occurred on the western solar limb; those resulting in the flare effects with the longest time scales occurred near the center of the solar disk. (Contractor's abstract)

1385

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

PARITY-NONCONSERVING INTERNUCLEON POTENTIALS. II. EFFECTS IN ELECTROMAGNETIC TRANSITIONS, by R. J. Blin-Stoyle. [1960] [9]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 120: 181-189, Oct. 1, 1960.

A detailed investigation is made of the way in which parity-nonconserving (PNC) internucleon potentials lead to parity impurities in nuclear states and hence to pseudoscalar asymmetries in the emission of gamma radiation. Explicit expressions are obtained for the angular distribution of unpolarized radiation (a) in emission from nuclei polarized by non-nuclear methods, (b) in β-γ angular correlations, (c) in polarized thermal neutron capture radiation and also for the magnitude of the circular polarization of radiation from an arbitrarily oriented nuclear system. The magnitudes of these effects are then estimated for the case of a transition between low-lying nuclear states and also for a ground-state transition following neutron capture. Finally a critique of the γ-ray transitions so far used in experimental investigations of PNC effects is given. It is concluded that many transitions in particularly simple nuclei are insensitive to PNC effects and that at present all that can be stated with any confidence is that $\mathcal{J} \leq 10^{-4}$-10^{-5}. (Contractor's abstract)

1386

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

PROPOSAL FOR MEASURING THE π^0 LIFETIME BY π^0 PRODUCTION IN ELECTRON-ELECTRON OR ELECTRON-POSITRON COLLISIONS. by F. E. Low. [1960] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 120: 582-583, Oct. 15, 1960.

The cross section for production of π^0 mesons by colliding electrons is calculated in the virtual photon approximation. This cross section is directly proportional to the inverse π^0 lifetime, and the proportionality

constant is independent of the strong couplings. For a center-of-mass energy of 300 mev and a π^0 mean life of 10^{-18} sec the total cross section is about 10^{-33} cm^2. (Contractor's abstract)

1387

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

AN INSTRUMENT FOR THE INVESTIGATION OF INTERPLANETARY PLASMA, by H. S. Bridge, C. Dilworth and others. [1960] [3]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]; and National Aeronautics and Space Administration) Unclassified

Published in Jour. Geophys. Research, v. 65: 3053-3055. Oct. 1960.

The instrument was designed to determine the density, direction, and magnitude of the bulk velocity of the protons of the interplanetary plasma. It is essentially a Faraday cup containing 4 grids which serve (1) to keep the electrons of the plasma from reaching the collector and (2) to suppress the photoelectric current by modulating the incoming protons without modulating the photoelectrons produced when the cup faces the sun. A transistorized electronic system amplifies, compresses, and demodulates the ac signal from the collector before transmitting it to the telemetry system of the vehicle. Current densities from 10^{-12} to 10^{-8} amp/cm^2, and proton kinetic energies from 10 to 3000 ev, can be measured. (Contractor's abstract)

1388

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

THE STATISTICAL MODEL AND NUCLEAR LEVEL DENSITIES, by T. Ericson. [1960] [87]p. incl. diagrs. refs. (AFOSR-999) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Also published in Advances in Phys., v. 9: 425-511, Oct. 1960.

A treatment from a theoretical point of view is given for the different aspects of the statistical model and nuclear energy densities. General features of nuclear level densities, including angular momentum and parity distributions, are discussed. Several models for their description are given including the equidistant spacing model, the free gas model, the Newton-Cameron model, the Rosenzweig effect, the Newson model, the pairing model, and the nuclear phase transition. The shell model without pairing interactions seemed to provide an adequate description of the neutron binding energy with empirical values of the single-particle spacing. Qualitative considerations, formal solution of classical approximation, and special limits of the statistical model and angular momentum conservation are discussed. The evaporation approximation, inverse cross sections, multiple emission of particles, emission of complex particles, statistical fission, lifetime of the compound state, and fluctuation of cross sections and angular distributions are also discussed.

1389

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

TERTIARY AND GENERAL-ORDER COLLISIONS (II), by L. M. Delves. [1960] [34]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Nuclear Phys., v. 20: 275-308, Oct. 1960.

The basis introduced in a previous paper (Nuclear Phys., v. 9: 391-399, Jan. 1959) for describing collisions involving more than 2 free particles in ingoing or outgoing channels is discussed in more detail. With this formalism channel wavefunctions for many-particle channels are formally identical to the usual 2-particle wavefunctions and require no special treatment. The scattering matrix referring to open channels is unitary and symmetric when many-particle channels are included; its symmetries in the complex k-plane are also discussed. Long-range effects in many-particle channels are considered, and it is shown that these can modify the threshold behavior of matrix elements given previously. Effective range expansions, valid for many-particle channels, are given for the reactance matrix and eigenphase shifts. (Contractor's abstract)

1390

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

USE OF BUBBLE CHAMBERS FOR EXPERIMENTS WITH HIGH ENERGY GAMMA-RAY BEAMS, by L. Guerriero, H. Mark and others. [1960] [4]p. incl. illus. diagr. table. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Rev. Scient. Instr., v. 31: 1040-1043, Oct. 1960.

Visual particle detection methods is used with high energy bremsstrahlung beams of low intensity. A method for obtaining a substantial increase in the γ-ray beam intensity which can be passed through a 9-in. propane bubble chamber is described. The beam is collimated

and then led through a hollow tube passing through the middle of the bubble chamber. It was found that use of a "beam tube" increases the number of events observed per picture by a factor between 5 to 10 over the number found with no beam tube. The 300 mev bremsstrahlung beam of the MIT synchrotron beam was used for these experiments. Advantages and limitations of the beam tube method are discussed. (Contractor's abstract)

1391

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

NUCLEAR ORIENTATION OF Mn^{54} AND Mn^{52m}, by R. W. Bauer, M. Deutsch and others. [1960] [6]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research Under [AT(30-1)-2098]) Unclassified

Published in Phys. Rev., v. 120: 946-951, Nov. 1, 1960.

The spins of the nuclides Mn^{54} (290 days) and Mn^{52m} (21 min), incorporated in the lattice of cerium magnesium nitrate and nickel fluosilicate crystals, have been oriented at low temperatures. The measurement of the angular distribution of the gamma rays from Mn^{54} indicate the spin of Mn^{54} to be 3 or 2; in the latter case, the beta decay must be predominantly of the Fermi type with an upper limit of 10% of a possible Gamow-Teller admixture. From a simultaneous measurement of the angular distribution of the gamma rays from Mn^{54} and 5.7-day Mn^{52} the ratio of the nuclear g values of the two isotopes is found, which yields a magnetic moment of of Mn^{54} of 2.55 ± 0.21 nm (for spin 3) or 2.16 ± 0.26 mn (for spin 2). The circular polarization measurements of the gamma rays from Mn^{54} determine this moment to be positive. Similar angular distribution experiments on Mn^{52m}, assuming spin 2, yield a magnetic moment of 1.04 ± 0.16 nm if the beta decay is predominantly a Gamow-Teller transition, or 0.72 ± 0.16 nm for a pure Fermi transition. These results indicate that the nuclear g values of the 21-min and the 5.7-day states of Mn^{52} are about the same. (Contractor's abstract)

1392

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

ENERGY LEVELS OF Ne^{21} AND Ne^{23}, by J. M. Freeman. [1960] [6]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 120: 1436-1441, Nov. 15, 1960.

The energies of 27 excited states of Ne^{21} and 17 of Ne^{23} have been established by a study of the (d,p) reactions in Ne^{20} and in Ne^{22}. Seven deuteron bombarding energies between 4.75 and 7.5 mev were used, and the target was a cell with thin windows, containing either natural or Ne^{22} enriched neon gas. The proton groups emitted at 90° were analyzed with a broad-range magnetic spectrograph. The established calibration of the spectrograph, in terms of alpha particles from polonium, together with some well-known reactions, provided the data necessary for precise energy determinations. The Q values obtained for the ground-state reactions Ne^{20}(d,p) Ne^{21} and Ne^{22}(d,p)Ne^{23} were 4.534 ± 0.009 mev and 2.79 ± 0.009 mev, respectively. Deuteron groups inelastically scattered from Ne^{20} and Ne^{22} were also observed. The higher energy groups were used in the calibration procedure; the lower energy groups gave the results 4.250 ± 0.008 mev and 3.356 ± 0.008 mev for the second excited states of Ne^{20} and Ne^{22}, respectively. The interpretation of the level schemes of Ne^{21} and Ne^{23} in terms of the collective model has been considered and is discussed briefly. (Contractor's abstract)

1393

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

SPINS OF THE ISOMERIC STATES OF Hf^{178} AND Hf^{180}, by M. Deutsch and R. W. Bauer. [1960] [5]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Nuclear Phys., v. 21: 128-132, Nov. 1960.

The 4.8 sec state of Hf^{178} and the 5.5 hr state of Hf^{180} are shown by angular correlation measurements to have spin J = 8. (Contractor's abstract)

1394

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

UNIQUENESS PROPERTY OF THE TWOFOLD VACUUM EXPECTATION VALUE, by P. G. Federbush and K. A. Johnson. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)-2098]) Unclassified

Published in Phys. Rev., v. 120: 1926, Dec. 1, 1960.

A generalization of previously known theorems regarding the vacuum expectation values of relativistic field theory operators has been demonstrated. If the vacuum expectation value of a simple 2-point function coincides with that for a free field at equal times, then all vacuum expectation values coincide with the corresponding free-field values.

1395

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

EXPERIMENTAL INVESTIGATION OF PARITY CONSERVATION IN THE 14.4-KEV GAMMA TRANSITION IN Fe^{57}, by L. Grodzins and F. Genovese. [1960] [2]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 121: 228-229, Jan. 1, 1961.

An experiment using recoilless resonance scattering on the 14.4-kev M1 gamma rays of Fe^{57} was performed to set a limit on the degree of parity in the nuclear states involved. The anisotropies of the $\Delta m = \pm 1$ gamma-ray transition rates were examined towards and away from the direction of the nuclear polarization. The use of recoilless resonance scattering allows the problem to be so overdetermined that instrumental anisotropies could be cancelled by appropriate summing of data. No parity-nonconserving anisotropy was observed. Taking into account the slowness of the M1 transition compared to a parity-admixed E1 transition of single-particle speed, a factor of 100 in amplitude, the limit on $\mathcal{F}$, the relative strength of a parity-admixed wave function is $\mathcal{F} < 10^{-5}$. (Contractor's abstract)

1396

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

LONG RANGE CORRELATIONS AND PHOTO EFFECT IN NUCL, by W. Brenig. [1960] [20]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Nuclear Phys., v. 22: 14-33, Jan. 1961.

A detailed quantum mechanical treatment of the collective model for the giant dipole resonance in the low energy nuclear photo effect is presented. A relation $\omega_D = ck_D$ for the resonance energy ω_D is derived from sum rule considerations, where k_D is related to the nuclear radius by $k_D \approx \pi/2R$ and c to the structure factor s(k) of nuclear matter at small momenta k by $s(k) = k/2mc$. The velocity c is calculated and the semiclassical expression for c in terms of the symmetry energy $K(c = 2K/m^2)$ is found to be valid only for extremely strong interactions. For weaker forces one obtains a larger value of c than indicated by this relation and a value of ω_D in better agreement with the results of shell model configuration mixing calculations. (Contractor's abstract)

1397

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

MINIMAL ELECTROMAGNETIC COUPLING FOR SPIN TWO PARTICLES, by P. [G.] Federbush. [1960] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Nuovo Cimento, Series X, v. 19: 572-573, Feb. 1, 1961.

The investigation of a charged spin 2 theory with minimal coupling is reported. It is noted that if the same Lagrangian that describes the linearized theory of general relativity is extended to charged massed spin 2 particles, the coupling cannot be minimal electromagnetic. Not only is the minimal electromagnetic coupling not unique, since it depends on the choice of the free Lagrangian, but in at least 2 theories, the usual 3/2 and spin 2 theories, it leads to inconsistencies. The type of inconsistency induced in spin 2 theory is suggestive of the difficulties encountered in the effort to avoid subsidiary conditions; but lack of a renormalizable theory of these spins keeps the question hypothetical.

1398

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

A TWO-DIMENSIONAL RELATIVISTIC FIELD THEORY, by P. [G.] Federbush. [1960] [3]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 121: -247-1249, Feb. 15, 1961.

A particular 2-dimensional relativistic field theory is considered. In some limit as the masses of the theory go to zero it approaches the Thirring model. By means of a formal transformation of the field operators the Hamiltonian is reduced to that of a free field. An improved perturbation expansion can be written down, necessitating only wave function renormalization, and it appears that the renormalized theory is consistent. The S matrix can be exhibited exactly, and though it leads to no physical scattering, it is not equivalent to

the unit matrix. Finally the renormalized current operator is displayed as a suitable limit of products of the renormalized field operators. The form of the result clearly separates the consistency problem in quantum electrodynamics from that of the "photon mass."

1399

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

HIGH RESOLUTION FOCUSING CERENKOV DETECTOR FOR HIGH ENERGY PARTICLES, by D. A. Hill, D. O. Caldwell and others. [1960] [7]p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)-2098]) Unclassified

Published in Rev. Scient. Instr., v. 32: 111-117, Feb. 1961.

A focusing differential Cerenkov counter of high velocity resolution using a gas radiator has been developed and used in relativistic particle beams. The optical and mechanical features are described. The velocity β can be varied continuously from 0.81 to 1.00. These counters give a velocity resolution $\Delta\beta/\beta$ of 0.0025 (half-width at half-maximum) at $\beta = 0.9985$ and an average efficiency for a 4-in. diam particle aperture of 0.7 in a particle beam collimated to $\pm 1°$. The sources of spurious response and the ultimate limitations of counters of this type are discussed. (Contractor's abstract)

1400

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

PAIRING FORCES AND NUCLEAR COLLECTIVE MOTION, by A. K. Kerman. [1960] [30]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Ann. Phys., v. 12: 300-329, Feb. 1961.

The influence of pairing forces on the collective vibrations in nuclei is studied using a perturbation expansion. The result is found to agree with that given by Belyaev using a superconductivity approximation except that here the number of particles is conserved. A general discussion is given of the collective quadrupole energy surface. In particular the anharmonic terms in the expansion about zero deformation and the general character of the stability of axially symmetric deformed systems are discussed. (Contractor's abstract)

1401

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

MAGNETIC MOMENT AND HYPERFINE STRUCTURE COUPLING OF THE FIRST 2+ STATE IN Gd^{154}, by R. Stiening and M. Deutsch. [1960] [9]p. incl. illus. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 121: 1484-1492, Mar. 1, 1961.

The g value of the 0.123-mev 2+ state of Gd^{154} is found to be $g = 0.36 \pm 0.06$. The hyperfine structure constant of the same nuclear state in the $^8S_{7/2}$ ground state of Gd^{3+} in aqueous solution is determined as $a = 26.4 \pm$ mc/sec. The perturbation of the angular correlation of gamma-ray cascades proceeding through this state was studied. It is found that the perturbation in aqueous solution can be decoupled by magnetic fields either parallel to one of the gamma rays or perpendicular to the plane of observation. The perturbation in molten $GdCl_3$ is found to be much weaker than in solution and to be unaffected by magnetic fields. Auxiliary measurements involving the first 2+ states in Sm^{152} and Gd^{156} are described. (Contractor's abstract)

1402

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

INCONSISTENCY OF THE LOCAL FIELD THEORY OF CHARGED SPIN 3/2 PARTICLES, by K. Johnson and E. C. G. Sudarshan. [1960] [20]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Ann. Phys., v. 13: 126-145, Apr. 1961.

The relativistic quantum theory of Fermi Dirac fields of arbitrary spin is investigated and a general theorem is proved which asserts that for fields of half integral spin $> \frac{1}{2}$, the possibility of a consistent quantization requires that the equal-time anticommutators must be functions of the other fields to which the field in question is coupled. The case of spin 3/2 is studied in detail and the equivalence of various formulations of the theory is shown. The inconsistency of the relativistic local quantum theory of a charged spin 3/2 field in interaction with an external electromagnetic field is demonstrated by showing that the equal time commutation relations and relativistic covariance of the theory are not compatible. Finally, the mixed spin 3/2-spin $\frac{1}{2}$ (Bhabha) field is found to be characterized by the same inconsistency. (Contractor's abstract)

1403

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

THE $^1S_0$ NUCLEON INTERACTION IN THE BOUNDARY CONDITION MODEL, by E. L. Lomon and M. Nauenberg. [1960] [6]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098) Unclassified

Published in Nuclear Phys., v. 24: 474-479, May 1961.

The nucleon-nucleon interaction model consisting of an energy independent boundary condition with an exponential potential tail is solved analytically for S states. The range of the potetnial is chosen to be approximately half of a meson Compton wavelength. The 3 remaining model parameters are fitted to the $^1S_0$ scattering length, effective range, and 210 mev phase shift. The strength of potential required is in agreement with the expectations of a meson theory. The phase shifts predicted at other energies between 0 and 310 mev are satisfactory. (Contractor's abstract)

1404

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

ION-FOCUSING PROPERTIES OF A THREE-ELEMENT QUADRUPOLE LENS SYSTEM, by H. A. Enge. [1960] [4]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)-2098]) Unclassified

Published in Rev. Scient. Instr., v. 32: 662-665, June 1961.

An analysis is presented of a three-element lens system in which the middle section has twice the length of each of the outside sections and the two outside sections have equal field-strength parameters. The results of thick-lens calculations are represented graphically indicating the field-strength parameters and magnifications as functions of object and image distances.

1405

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

THE PION-PION INTERACTION IN τ DECAY, by E. Lomon, S. Morris and others. [1960] [20]p. incl. diagrs. tables, refs. [Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under AT(30-1)2098] Unclassified

Published in Ann. Phys., v. 13: 359-378, June 1961.

The momentum dependence of the τ-decay rate deviates considerably from that predicted by the relativistic phase space factor and Coulomb corrections. The difference is attributed here to the final state pion pion interaction. Three different phenomenological analyses are made to determine the T = 0 and T = 2 s-state pion-pion force required for consistency with τ and τ' data: a scattering length approximation, an independent pair approximation for an exponential potential, and a Born approximation for a Yukawa potential. The results of all 3 approximations agree where they are applicable and indicate a weak or repulsive T = 0 force and an attractive T = 2 force. (Contractor's abstract)

1406

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

ELASTIC AND INELASTIC SCATTERING OF NEUTRONS BY DEUTERONS NEAR THE INELASTIC THRESHOLD, by L. M. Delves. [1960] [11]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Nuclear Phys., v. 26: 136-146, July 1961.

A calculation is made of the neutron-deuteron s-wave elastic and inelastic scattering cross-sections which includes the interaction between these 2 channels. The scattering matrix given by this method is unitary. Comparison is made with a calculation of the elastic scattering using the same potentials but neglecting the effect of the inelastic channel. Large differences are found, indicating that it is important to include the deuteron distortion in elastic scattering calculations; however, this conclusion may be due at least partly to neglect of charge exchange scattering. The proton energy spectrum predicted by the model is the phase-space spectrum. This is identical with that of Frank and Gammel except near the upper end of the spectrum, where it agrees better with experiment at the energies considered. The size of the anomaly in the elastic scattering cross-section at the inelastic threshold is calculated, and found to be rather small.

1407

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

PROTONS FROM ALPHA-INDUCED REACTIONS, by W. Swenson and N. Cindro. [1960] [13]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)2098]) Unclassified

Published in Phys. Rev., v. 123: 910-922, Aug. 1, 1961.

The results of proton energy spectra measured at several angles from 30.5 mev alpha particle induced reactions on Al^{27}, V^{51}, Co^{59}, As^{75}, Nb^{93}, Rh^{103}, In^{115}, and Ta^{181} were analyzed using the statistical model. The analysis yielded the differential cross section $d^2\sigma/d\Omega\, dE$ and the relative level density $\omega(E)$ of the residual nuclei as a function of proton and excitation energy of the residual nucleus. The nuclear temperature $1/T = d(\ln\omega)/dE$ and the level density parameter a of $\omega = C \exp[(aE)^{\frac{1}{2}}]$ were obtained. The energy and angular dependence of the spectra are adequately described by the statistical model at back angles, with the indication of the presence of a direct-reaction mechanism contribution at forward angles, which extends to high excitation energies. (Contractor's abstract)

1408

Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge.

SINGLE-QUANTUM ANNIHILATION OF POSITRONS, by L. Sodickson, W. Bowman and others. [1960] [11]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [AT(30-1)-2098]) Unclassified

Published in Phys. Rev., v. 124: 1851-1861, Dec. 15, 1961.

An experiment was performed to investigate single-quantum annihilation of positrons in the field of high-Z nuclei. This mode of annihilation was observed and the absolute magnitude, energy dependence, and Z dependence of the cross-section measured. Backgrounds which might contaminate the derived signals were empirically investigated and found to be an order of magnitude or more below the rate identified as single-quantum annihilation. The data on absolute magnitude of the counting rate and its dependence on positron energy agree with the calculation of Jaeger and Hulme. The Z dependence agrees with a cross section proportional to Z^5. (Contractor's abstract)

1409

Massachusetts Inst. of Tech. [National Magnet Lab.] Cambridge.

UNRESTRICTED HARTREE-FOCK METHOD: ELECTRON DENSITIES AND MAGNETIC FORM FACTORS FOR SPIN POLARIZED Ni^{++}, by R. E. Watson and A. J. Freeman. [1960] [11]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force [Office of Scientific Research under AF 19(604)7344, Office of Naval Research, and Signal Corps] Unclassified

Published in Phys. Rev., v. 120: 1125-1134, Nov. 15, 1960.

The effect of relaxing the restrictions associated with the Hartree-Fock method is discussed with particular emphasis on that constraint which requires common radial behavior for wave functions with all quantum numbers except m_s in common. Results of such a spin polarized Hartree-Fock self-consistent field calculation are reported for the Ni^{++} ion and related to earlier calculations of Wood and Pratt, and Heine. Emphasis is placed on a consideration of the effects on the electron density and on x-ray and magnetic form factors. Spin polarization of the 3d shell and the core results in an interesting effect on the magnetic form factor for this case. Results of calculations of several hyperfine parameters which are in rough agreement with experimental results are also presented.

1410

Massachusetts Inst. of Tech. [National Magnet Lab.] Cambridge.

CRYSTALLINE FIELD AND SPIN POLARIZATION EFFECTS ON ELECTRON DENSITIES AND MAGNETIC FORM FACTORS, by R. E. Watson and A. J. Freeman. [1960] [8]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force [Office of Scientific Research under AF 19(604)7344, Office of Naval Research, and Signal Corps] Unclassified

Published in Phys. Rev., v. 120: 1134-1141, Nov. 15, 1960.

The combined effects of spin (or exchange) polarization and an external crystalline field on charge densities, x-ray and magnetic form factors, and hyperfine parameters are investigated following the analytic Hartree-Fock self-consistent field approach. The crystalline field is represented by a crude cubic field arising from an octahedral array of point charges surrounding the central ion. In the strong field approximation the atomic 3d electrons are split by the crystalline field and the spin polarization effect, resulting in a description of these electrons by a set of three distinct orbitals. The ion's spin density leads to a Fermi contact term in better agreement with experiment than the value reported earlier (item no. 1409, Vol. IV).

1411

Massachusetts Inst. of Tech. [National Magnet Lab.] Cambridge.

CALCULATION OF THE CRYSTALLINE FIELD STRENGTH: CHROME ALUM, by A. J. Freeman and R. E. Watson. [1960] [7]p. incl. diagrs. refs. (Sponsored jointly by Air Force [Office of Scientific Research under AF 19(604)7344, Office of Naval Research, and Signal Corps] Unclassified

Published in Phys. Rev., v. 120: 1254-1260, Nov. 15, 1960.

A calculation of the crystalline field strength, D_q, is reported for chrome alum, using Kleiner's model and crystal field potential, and recently determined Hartree-Fock wave functions for Cr^{+3} ion. Particular emphasis is placed on a consideration of reported point charge calculations and Phillips' method of including the effects of orthogonalization of ligand to metal ion wave functions. Kleiner's sign for D_q is reversed and a small positive D_q is obtained, but in such a way as to contradict Phillips' conclusions. A discussion is given of the various evidence for the inadequacy of the electrostatic potential theory and some of the necessary modifications are indicated. (Contractor's abstract, modified)

1412

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

DESIGN, CALIBRATION AND ANALYSIS OF A HELIUM CONCENTRATION METER, by J. R. Brown. Dec. 1959, 27p. incl. diagrs. (Technical rept. no. 416) (AFOSR-TN-60-39) (AF 49(638)245) AD 235986; PB 147782 Unclassified

The mass transfer investigation is concerned with the consequences of binary-mixture flow in the high speed boundary layer. Measurement of the boundary layer composition using a sound-speed concentration meter is an important part of the program. The design, calibration and analysis of a helium concentration meter is reported. (Contractor's abstract)

1413

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

THE LAMINAR DIFFUSION BOUNDARY LAYER WITH EXTERNAL FLOW FIELD PRESSURE GRADIENTS, by J. R. Baron and P. B. Scott. Dec. 1959, 67p. incl. diagrs. tables, refs. (Technical rept. no. 419) (AFOSR-TN-60-830) (AF 49(638)245) AD 241470; PB 149342 Unclassified

An analysis and sample solutions are presented for the 2-dimensional laminar boundary layer in the presence of foreign gas injection and a non-uniform external flow field. Similarity restrictions are given and numerical results shown for the case of helium injection into an external air flow at vanishing Mach number. The external flow field is described by a natural extension of the Falkner-Skan wedge solutions. Pressure gradients prove to have appreciable effects upon skin friction, heat transfer, and boundary layer separation. (Contractor's abstract)

1414

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

APPLICATION OF COVERT'S APPROXIMATIONS FOR THE BINARY BOUNDARY-LAYER TO A POROUS CONE WITH A SOLID TIP, by J. P. Moran. June 1960, 81p. incl. diagrs. tables, refs. (Technical rept. no. 442) (AFOSR-TN-60-442) (AF 49(638)245) AD 247915; PB 153103 Unclassified

Covert's approximations to the solutions to the laminar binary boundary-layer equations as derived by Baron are critically analyzed for the case of helium injected into an air boundary layer. The assumed constant similarity integrals employed by Covert (item no. 1072, Vol. III) are evaluated for a helium air boundary layer by use of the exact wedge-flow solutions of Baron and Scott (item no. 1413, Vol. IV). These approximate relations are applied to the problem of a porous cone having a solid tip. The solutions show that the approximations to the shear and concentration equations give reasonable results, but that the approximations to the energy equation do not. (Contractor's abstract)

1415

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

A MASS TRANSFER FINITE DIFFERENCE FORMULATION EMPLOYING CROCCO VARIABLES, by J. P. Moran and P. B. Scott. June 1960, 81p. incl. diagrs. refs. (Technical rept. no. 443) (AFOSR-TN-60-846) (AF 49(638)245) AD 247913; PB 153104 Unclassified

Also published in Jour. Aero/Space Sci., v. 28: 737-738, Sept. 1961.

Solutions to the laminar boundary-layer equations have been obtained by Flügge-Lotz and Baxter using a finite difference formulation. The same difference approximations are used here to develop a formulation for the binary boundary-layer equations for the case of helium injection into an air stream. This formulation is used in obtaining solutions to the problem of a porous cone having a solid tip, the porous region having an injection function of the form $k/\sqrt{x_c}$. Corresponding solutions using Covert's approximations to the equations are compared with the finite difference solutions. For low levels of injection Covert's approximations to the concentration and shear equations show good agreement with the finite difference solutions. (Contractor's abstract)

1416

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

THE COMPRESSIBLE TURBULENT BOUNDARY LAYER WITH SURFACE MASS TRANSFER, by F. E. C.

Culick. Aug. 1960, 64p. incl. diagrs, refs. (Technical rept. no. 454) (AFOSR-TN-60-1094) (AF 49(638)-245) AD 247914; PB 153105 Unclassified

Also published in Jour. Aero/Space Sci., v. 28: 745-747, Sept. 1961. (Title varies)

An approximate analysis of the compressible turbulent boundary layer on a porous flat plate with distributed surface mass transfer is based on a representation comprising 2 regions. A large portion of the development is quite general, but only the cases of helium and air injection are computed explicitly. The results are restricted to conditions under which the Prandtl and Schmidt numbers may be regarded as functions of concentration alone. Wall concentration of helium and the reduction in skin friction can be calculated from a modified integral method; heat transfer and recovery temperatures are obtained from the differential energy equation. There seems to be acceptable agreement with measurements, with the exception of optimistic recovery factors and a failure to show observed dependence of skin friction on Mach numbers. An approximate calculation indicates that if the effects of thermal diffusion are accounted for, the first error may be decreased, with but small change in the calculated heat transfer rate. (Contractor's abstract)

1417

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

HEAT TRANSFER RATES AND INSULATED WALL TEMPERATURES FOR A TRANSPIRATION COOLED HEMISPHERE, by A. F. Gollnick, Jr. Dec. 1960, 135p. incl. illus. diagrs. table, refs. (Technical rept. no. 433) (AFOSR-TN-60-1483) (AF 49(638)245) AD 278447 Unclassified

Existing solutions to the boundary layer equations with helium injection and constant free stream pressure gradient are used to calculate the injection distribution on a hemisphere required to maintain a constant wall temperature. The method used is an extension of the wedge-matching technique. The fabrication and calibration of a wind tunnel model designed on this basis is described. The resulting distributions of wall temperature, insulated wall temperature and Stanton number are presented, as well as the variation of these quantities with injection rate, using air and helium as coolants. The design technique proved satisfactory. The insulated wall temperature near the nose, for helium injection, is nearly 10% higher than the tunnel stagnation temperature. It is suggested that this may result from the thermal diffusion of the helium within the boundary layer. The Stanton numbers obtained with air and helium agree with theoretical predictions, and the corresponding heat fluxes demonstrate that mass transfer cooling on a blunt body is very effective. On the other hand, the anticipated superiority of helium over air does not occur, since the adverse effect of helium injection on the insulated wall temperature negates the corresponding reduction in heat transfer coefficient. (Contractor's abstract)

1418

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

AN EXPERIMENT WITH A TRANSPIRATION-COOLED NOZZLE, by R. P. Bernicker. July 1960, 73p. incl. illus. diagrs. tables, refs. (Technical rept. no. 447) (AFOSR-TN-60-1484) (AF 49(638)245) AD 254260; PB 155810 Unclassified

Also published in Jour. Aero/Space Sci., v. 28: 658-659, Aug. 1961. (Title varies)

An experimental investigation of the cooling of a nozzle exposed to a high energy gas stream was designed and carried out in the Naval Supersonic Lab. hypersonic wind tunnel circuit. Cooling was effected by means of a porous strip located in the subsonic region of the 2-dimensional nozzle, through which both "cold" helium and air were injected into the boundary layer. Thermocouple measurements were made on the impermeable surface downstream from the injection section to determine the residual effect of cooling under various conditions of coolant mass flow rate, stagnation temperature, and coolant gas used. Two test nozzles were fabricated; each having the porous injection section located at a different position with respect to the nozzle throat. Data were correlated and results indicated that a wall cooling parameter could be expressed as a function of the injection rate for both models tested. The decay of the cooling achieved with distance was determined to be a power function of the downstream distance after injection, the exponential term being a function of the injection rate. Limited analytical results for zero pressure gradient flows yielded a basis for the resulting form of the decay function. (Contractor's abstract)

1419

Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge.

SOME MASS-TRANSFER RESULTS WITH EXTERNAL-FLOW PRESSURE GRADIENTS, by J. R. Baron and P. E. Scott. [1960] [2]p. incl. diagrs. (AF 49(638)245) Unclassified

Published in Jour. Aero/Space Sci., v. 27: 625-626, Aug. 1960.

A brief summary is presented of an analysis and sample solutions for the 2-dimensional laminar boundary layer in the presence of foreign gas injection and a non-uniform external flow field. Pressure gradients prove to have appreciable effects upon skin friction, heat transfer, and boundary layer separation.

1420

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

SENSORY COMMUNICATION: CONTRIBUTIONS TO THE SYMPOSIUM ON PRINCIPLES OF SENSORY COMMUNICATION, Endicott House, M.I.T. (July 19-Aug. 1, 1959), ed. by W. A. Rosenblith. [Cambridge] M.I.T. Press, 1961, 844p. incl. illus. diagrs. tables, refs. (AFOSR-796) (AF 49(638)421) AD 262150
Unclassified

This meeting is the product of a common interest in problems of sensory communication among life scientists, physical scientists, and communications and computer engineers in the postwar era. This volume consists of 38 chapters presenting experimental results and theoretical considerations from a variety of approaches. It is aimed to present evidence that should prove useful to the formulation of principles of sensory communication.

1421

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ANATOMY AND PHYSIOLOGY OF VISION IN THE FROG (RANA PIPIENS), by H. R. Maturana, J. Y. Lettvin and others. [1959] [48]p. incl. illus. diagrs. refs. (AFOSR-TN-60-1148) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [AF 49(638)724]) AD 248121 Unclassified

Presented at Mechanisms of Vision Symposium, Caracas (Venezuela), July 31-Aug. 3, 1959.

Also published in Jour. Gen. Physiol., v. 43: Suppl. 2, 129-175, July 1960.

The function of the retinal ganglion cells of the frog is studied in response to light and dark objects of various sizes and shapes moved in the visual field against various backgrounds. These cells form 5 natural classes. Four of them act on the visual image to perform complex analytical operations that remain invariant under changes of general illumination and general outlook of the visible environment. The fifth class measures light intensity. The axons of the cells of each class end in a separate layer of terminals in the superficial neuropil of the tectal lobes. However, 2 of them are mixed so that they really form 4 fundamental layers of terminals. Each of these layers forms a continuous map of the retina with respect to the operation performed by the corresponding ganglion cells. The retina transforms the visual image from a mosaic of luminous points to a system of overlapping qualitative contexts in which any point is described in terms of how it is related to what is around it.

1422

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

WHAT THE FROG'S EYE TELLS THE FROG'S BRAIN, by J. Y. Lettvin, H. R. Maturana and others. [1959] [12]p. incl. diagrs. refs. (AFOSR-TN-60-1175) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [AF 49(638)724] and Bell Telephone Labs., Inc.)
Unclassified

Also published in Proc. Inst. Radio Engineers, v. 47: 1940-1951, Nov. 1959.

The activity of single fibers in the optic nerve of the frog is analyzed to determine the type of stimulus which causes the largest activity in one nerve fiber. Results indicate that for the most part within the retinal area, the pattern of local variation is the exciting factor. There are 4 distinct parallel distributed channels whereby the frog's eye informs his brain about the visual image in terms of local pattern independent of average illumination. The patterns are described and the functional and anatomical separation of the channels are illustrated. (Contractor's abstract, modified)

1423

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

TWO REMARKS ON THE VISUAL SYSTEM OF THE FROG, by J. Y. Lettvin, H. R. Maturana and others. Final rept. Sept. 1, 1959-Apr. 30, 1960 [34]p. incl. diagrs. (AFOSR-TR-60-77) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-724, Bell Telephone Labs., Inc., Office of Naval Research, and Signal Corps) AD 243858 Unclassified

Also published in Sensory Communication: Contributions to the Symposium on Principles of Sensory Communication, Endicott House, M.I.T. (July 19-Aug. 1, 1959) [Cambridge] M.I.T. Press, 1961, p. 757-776. (AFOSR-796)

I. The form-function relations in the retina are discussed. There are significant differences in the shapes of dendritic fields of different size and there are equally great differences in the operations done by fibers with receptive fields of different sizes. It is proposed that it is possible to decipher the anatomical differences by means of the functional differences. This leads to a hypothesis that (with respect to the discrimination of silhouettes) the inner levels of the inner plexiform layer are concerned with boundaries, whereas the outer levels are concerned with average (or changes in the average) illumination. This can be extended to account for the fact that bipolar cells that end exclusively in the outer levels of the inner plexiform layer are connected only to cones, whereas those that end deepest in the inner layers are connected to both sorts of rods as well

as the cones. II. Two types of cells in the colliculus that receive information from the optic nerve fibers are discussed. (a) "Newness" neurons are concerned with detection of novelty in visual events. (b) "Sameness" neurons are concerned with continuity in time of interesting objects in the field of vision.

1424

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE FINE ANATOMY OF THE OPTIC NERVE OF ANURANS - AN ELECTRON MICROSCOPE STUDY, by H. R. Maturana. [1959] [29]p. incl. illus. diagrs. refs. (AFOSR-5195) (In cooperation with Harvard U., Cambridge, Mass.) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [AF 49(638)724]) Unclassified

Published in Jour. Biophys. and Biochem. Cytol., v. 7: 107-120, 1960.

In the optic nerve of Anurans numerous myelinated and unmyelinated axons appear under the electron microscope as compact bundles that are closely bounded by 1 or several glial cells. The unmyelinated fibers are more numerous than the myelinated fibers and are separated from each other, from the glial cells, or from myelin sheaths by a continuous extracellular gap. The myelinated axons do not follow any preferential course and shift their relative position and pass from 1 bundle to another. At the nodes of Ranvier they behave entirely like unmyelinated axons in their relations to the surrounding cells. At the internodes they lie between the unmyelinated axons without showing an obvious myelogenic connection with the surrounding glial cells. The mode of ending of the myelin layers at the nodes of Ranvier and the spiral disposition of the myelin layers indicate that myelination of these fibers occurs by a process similar to that of peripheral nerves. (Contractor's abstract)

1425

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MICROWAVE DETERMINATION OF THE COLLISION CROSS SECTION AND OF THE ENERGY LOSS OF SLOW ELECTRONS IN HYDROGEN (Abstract), by G. Bekefi and S. C. Brown. [1958] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-64637] and Atomic Energy Commission) Unclassified

Published in Conf. on Physics of Electronic and Atomic Collisions, Program and Abstracts of Papers, New York U., New York, Jan. 27-28, p. 9-10.

The electron collision cross section for momentum transfer and the fractional energy loss per collision with a hydrogen molecule are determined from the electric conductivity of a gaseous plasma. At room temperature the collision cross section P_m is 28(cm-mm Hg)$^{-1}$ and increases as $\nu^{0.6}$, where ν is the electron velocity. The fractional energy loss per collision depends strongly on the electron energy. For instance, when the electron temperature is raised from 300°K to 900°K the loss increases five-fold.

1426

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

UNEQUAL POPULATIONS OF CLOSELY SPACED ENERGY LEVELS IN ATOMS EXCITED BY ELECTRON IMPACT (Abstract), by B. B. Aubrey and L. C. Bradley, III. [1958] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-64637]) Unclassified

Published in Conf. on Physics of Electronic and Atomic Collisions, Program and Abstracts of Papers, New York U., New York, Jan. 27-28, 1958, p. 21-22.

Unidirectional electrons are used to excite the metastable $^3P_2$ state in mercury vapor. The relative populations of the magnetic sublevels of this state are studied by measuring the absorption of the vapor for polarized λ = 5461A light. The polarization of the 6^3P_2 state in the even isotopes of mercury and the polarization in the various hyperfine structure levels of this state in Hg^{199} and Hg^{201} are measured.

1427

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE STATISTICAL THEORY OF INFORMATION, by R. M. Fano. [1958] [20]p. incl. diagrs. table. [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108] Unclassified

Presented at Internat'l. School of Physics, Varenna (Italy), July 7-19, 1958.

Published in Nuovo Cimento, Series X, Suppl., v. 13: 353-372, 1959.

The notion of quantity of information is defined and the content of Shannon's 2 fundamental theorems is explained. The first shows that the information content of a message can be directly related to the number of code-symbols it contains. The second is that coding methods exist such that the effect of random errors

can be eliminated with high probability, at the expense of lengthening the message by introducing checking symbols into it.

1428

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

STATISTICAL FILTERING AND PREDICTION, by Y. W. Lee. [1958] [25]p. incl. diagrs. [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108] Unclassified

Presented at Internat'l. School of Physics, Varenna (Italy), July 7-19, 1958.

Published in Nuovo Cimento, Series X, Suppl., v. 13: 430-454, 1959.

The problem of designing a linear filter circuit such that, if the input is the sum of a message plus a noise, the output shall resemble the message as closely as possible, is considered. The criterion of resemblance is taken to be that the mean-square error is a minimum and it is shown that this determines uniquely the frequency response of the filter circuit. This determination requires the solution of Weiner-Hopf integral equation, an explicit solution of which is given. The errors can be reduced if a time lag is accepted between message and output which cannot be removed altogether. The problem of prediction (extrapolating a given function forward in time) is a special case of this general theory. The minimum mean-square error can be computed in terms of the desired time-interval.

1429

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

QUESTIONS OF LINGUISTICS, by M. Halle. [1958] [24]p. incl. tables. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and National Science Foundation) Unclassified

Presented at Internat'l. School of Physics, Varenna (Italy), July 7-19, 1958.

Published in Nuovo Cimento, Series X, Suppl., v. 13: 494-517, 1959.

Chomsky's phase-structure rules are analyzed and are clarified by examples. Individual sounds (segments) are studied along with several rules indicating their relationships to word formulation. It is also postulated that human languages are similar to each other phonetically and do not exhibit an unpredictable or unlimited difference. Finally, the relationship between descriptive devices (phonetic attributes and segments) and the data of linguistics is discussed.

1430

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

POINT-CONTACT DIODES IN TERMS OF p-n JUNCTION THEORY, by R. E. Nelson. [1958] [8]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in I.R.E. Trans. on Electron Devices, v. ED-6: 270-277, July 1959.

An idealized abrupt hemispherical p-n junction is assumed to be an appropriate model for a germanium point-contact diode which has been formed. A low-injection analysis indicates that the model is capable of describing the experimentally-observed behavior. Predicted values of punchthrough or breakdown voltages correspond to observed peak inverse voltages of germanium point contacts. Comparison between computed high-injection analysis of forward characteristics and some experimental data discloses an approximate agreement and suggests a graded p-n junction as a suitable improved model. (Contractor's abstract, modified)

1431

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SIGNAL-CANCELLATION TECHNIQUES FOR CAPTURING THE WEAKER OF TWO COCHANNEL FM SIGNALS, by E. J. Baghdady. [1958] [25]p. incl. illus. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 241715 Unclassified

Also published in Electromagnetic Wave Propagation; Internat'l. Conf., Brussels (Belgium) [1958], London, Academic Press, 1960, p. 183-207.

A conventional FM receiver captures the stronger of 2 cochannel FM signals and suppresses irretrievably the weaker signal. But this is only a limitation of conventional FM demodulators. Two general, laboratory-tested, signal-cancellation techniques—dynamic trapping and feedforward—are described to show how the message carried by the weaker of 2 cochannel FM signals can be reproduced with negligible distortion even when its amplitude is much smaller than that of the stronger signal. The application of these methods to the realization of a 2-carrier, single-channel, "amplitude-discrimination" FM multiplex system is also discussed. (Contractor's abstract)

1432

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

A WIDE-RANGE ELECTROSTATIC LOUDSPEAKER, by C. I. Malme. [1959] [8]p. incl. illus. table, refs. (Sponsored jointly by [Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108] and Office of Naval Research under Nonr-184142) Unclassified

Published in Jour. Audio Eng. Soc., v. 7: 47-54, Jan. 1959.

A newly designed wide-range electrostatic loudspeaker incorporates: (1) push-pull operation with a light 20-in. diameter, peripherally-supported diaphragm; (2) a high-resistivity coating on the diaphragm surfaces to give constant-charge operation without the use of an external series resistor; (3) a bias voltage of 16 kv applied through a corona-ring around the edge of the diaphragm; (4) a high-output-voltage audio amplifier; (5) large diaphragm excursion to allow low-frequency reproduction; and (6) electrical segmentation of the diaphragm to give broad directivity patterns at all frequencies. The loudspeaker is capable of a frequency response essentially flat within ± 8 db from 16 cps to 16,000 cps. Total harmonic distortion at 16 cps is 6%. The figures quoted are for a sound pressure level of 80 db measured at a distance of 6 ft on a loudspeaker axis in an anechoic chamber. (Contractor's abstract)

1433

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

THE RELIABILITY OF BIOLOGICAL SYSTEMS, by W. S. McCulloch. [1959] [18]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108] and National Institutes of Health) Unclassified

Published in Proc. of the Interdisciplinary Conf. on Self-Organizing Systems, Chicago, Ill., (May 5-6, 1959), New York, Pergamon Press, 1960, p. 264-281.

The redundancy of calculation is studied in terms of information theory for possible interpretations of the neuronal net functions in the brain. The description of the functions computed by neurons are derived from Venn's diagrams for the intersection of classes. A mathematical development is synthesized to show the possibility of creating an infallible network of fallible neurons, in spite of gross perturbation of threshold, of excitation and of local synapsis.

1434

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

QUANTITATIVE METHODS IN THE ANALYSIS OF NEUROELECTRIC ACTIVITY, by T. T. Sandel, C. E. Molnar and others. [1959] [7]p. incl. illus. diagrs. (In cooperation with Massachusetts Inst. of Tech., Lincoln Lab.) [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108] Unclassified

Published in Medical Electronics, Proc. of the Second Internat'l. Symposium, Paris (France) (June 24-27, 1959), London, Iliffe and Sons, Ltd., 1960.

A digital computer has been programmed which utilizes the averaging technique in relation to waveform deflections. This technique is applicable to studies of evoked potentials recorded from the scalp of intact humans, studies of rates at which various neural structures are capable of following sensory stimuli and the influence of pharmacological agents and physiological states upon evoked responses in animals. In order to gain further insight into the periodic aspects of the electroencephalogram, the most familiar example of on-going activity, correlation analysis has been used, in the forms of both autocorrelation and cross-correlation.

1435

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

TWO TRANSMISSION SYSTEMS FOR SKIN SENSATIONS, by P. D. Wall. [1959] [22]p. incl. illus. diagr. refs. (AFOSR-1291) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]; Bell Telephone Labs., Public Health Service, and Teagle Foundation) Unclassified

Published in Sensory Communication; Contributions to the Symposium on Principles of Sensory Communication, Endicott House, M.I.T. (July 19-Aug. 1, 1959) [Cambridge] M.I.T. Press, 1961, p. 475-496. (AFOSR-796)

Microelectrode studies are described of two groups of (cat) cells (one in the dorsal horn of the lumber region of the spinal cord, and the other in the nucleus gracilis) receiving direct afferent fibers from the skin. A comparison is made of these two types of cells involved in the transmission of information from the skin, and summarized as follows: (1) The origin of the amplification of cells act as amplifiers is discussed. (2) The cells act as points of convergence of fibers from different parts of the skin. Each cell subserves a larger area of skin than any one afferent fiber. The anatomy of this convergence is dependent on the presence of microbundles of fibers. (3) The cells act as points of convergence of fibers of different types: the nucleus gracilis

cells respond only to the largest fibers in the skin nerves; the dorsal horn cells respond as though all types of skin fibers terminated on them. (4) The temporal impulse pattern of activity of the cells on which many types of fiber converge differs, depending on the nature of the stimulus. (5) The output pattern of impulses is a consequence of two factors, the nature of afferent fibers converging on the cells and the interconnections between the cells. These factors determine what may be sensed by subsequent stages in the nervous system.

1436

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

CESIUM PLASMA DIODE AS A HEAT-TO-ELECTRICAL-POWER TRANSDUCER, by W. B. Nottingham. [1959] [21]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 238296 Unclassified

Also published in Proc. Fourth Internat'l. Conf. on Ionization Phenomena in Gases, Uppsala (Sweden) (Aug. 17-21, 1959), Amsterdam, North-Holland Publishing Co., v. 1: 486-506, 1960.

The interest in the direct conversion of heat-to-electrical power has stimulated research in both the application of the high vacuum diode and the plasma diode to accomplish this purpose. The theory of the high vacuum diode is relatively simple and the experimental verification of the theory has been satisfactory. The plasma diode which depends on the ionization of cesium at a hot surface cannot be worked out in all of its detail at present because of the lack of certain fundamental experimental data. It is possible to make use of published results of Taylor and Langmuir (Phys. Rev., v. 44: 423, 1933) and a detailed analysis of recent thermionic studies to carry the understanding of the plasma diode far enough to make a direct comparison with experiment. This analysis first involves an understanding of the phenomenon of surface ionization. General properties of a plasma and space-charge considerations control the delivery of ions to neutralize electron space charge. When applied to the experimental data available, an interesting result comes as an important simplification. Essential to the theory of the high vacuum diode is the knowledge of the emitter temperature and the diode spacing. This fact supports the opinion that the efficiency of the plasma diode may be tremendously improved over that of vacuum diodes of practical design. (Contractor's abstract)

1437

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

HIGH FREQUENCY WAVES IN IONIZED GASES, by S. C. Brown. [1959] [8]p. incl. diagrs. (Sponsored jointly by [Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108] and Atomic Energy Commission under AT(30-1)1842) Unclassified

Published in Proc. Fourth Internat'l. Conf. on Ionization Phenomena in Gases, Uppsala (Sweden) (Aug. 17-21, 1959), Amsterdam, North-Holland Publishing Co., v. 2: IIIC 691-IIIC 696, 1960.

A simplified analysis of the interaction of an electromagnetic field with a plasma in the presence of a magnetic field is presented. The particular cases of radiation in the absence and in the presence of a magnetic field are also considered. Strong resonances corresponding to much higher frequencies in a region corresponding to a geometrical mean frequency between the electron and ion cyclotron frequencies are observed. At low ion densities these hybrid frequencies are indistinguishable from pure ion resonances. As the ion density increases, the resonances separate more and more from the pure ion cyclotron resonance.

1438

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE ANALYSIS OF NUCLEAR RESONANCE SPECTRA, by J. S. Waugh. [1959] [17]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], Alfred P. Sloan Foundation, and National Science Foundation) Unclassified

Presented at Fourth Internat'l. meeting on Molecular Spectroscopy, Bologna (Italy), Sept. 7-12, 1959.

Published in Advances in Molec. Spectros., v. 1: 160-174, 1962.

The molecular magnetic polarization and spin-spin coupling constants are determined and the forces leading to spin pairing in molecular orbitals are investigated. Applications of the theory are made to studies of the electronic structure of molecules. The study is analogous to that made for the infrared problem of determining the force constants of the individual bonds in a molecule from observed normal frequencies.

1439

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ANALYTICAL DESIGN OF PARAMAGNETIC AMPLIFIERS, by M. W. P. Strandberg. [1959] [10]p. incl. illus. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Quantum Electronics; A Symposium, High View, N. Y. (Sept. 14-16, 1959), New York, Columbia U. Press, 1960, p. 515-524.

A description of useful amplifier parameters is presented, and the performance that can be expected from such a device is discussed. The magnetic Q_x that can be obtained is computed for ruby with Al:Cr = 1:10^{-4} at about 200, T = 4.2°K, at 3 cm. The gain bandwidth will be ≈ 45 mc. If the temperature is reduced to 1.5°K the magnetic Q will be reduced to about 70, but the gain-bandwidth will only go to 63 mc. Thus the maximum gain-bandwidth product for a single pink ruby amplifier at any frequency should be less than 100 mc unless very cleverly executed steps are taken to artificially widen the paramagnetic linewidth.

1440

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CATHODOLUMINESCENCE OF EVAPORATED ZINC SULFIDE-MANGANESE FILMS, by J. P. Reames. [1959] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and Bureau of Ships) Unclassified

Published in Trans. Sixth Nat'l. Symposium on Vacuum Technology, Philadelphia, Pa. (Oct. 7-9, 1959), London, Pergamon Press, 1960, p. 215-217.

The cathodoluminescence of thin evaporated ZnS-Mn films is investigated by varying both the manganese concentration and the postheat time. The effect of different powders and experimental techniques are described in detail. A superior method of evaporating zinc sulfide by means of electron bombardment heating and an ion collecting electrode is explained. (Contractor's abstract)

1441

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

CYCLOTRON RADIATION FROM PLASMAS (Abstract), by J. L. Hirshfield and G. Bekefi. [1959] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at Twelfth annual Gaseous Electronics Conf., Washington, D. C., Oct. 14-16, 1959.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 124, Mar. 4, 1960.

The incoherent microwave noise from the positive column of a dc discharge subjected to an external magnetic field was measured at frequencies in the neighborhood of the electron cyclotron frequency. The radiation was observed along, and perpendicular to, the magnetic field for various electron densities and gas pressures. Kirchoff's radiation law for anisotropic media, which relates the emission to the absorption, was used to interpret the measurements. The absorption was obtained from the tensor rf conductivity of a cold plasma of low degree of ionization. When the plasma is transparent, the emission reduces to that obtained by summing the radiation from individual electrons orbiting in the magnetic field. This result is used in finding the electron temperature by integrating the radiation intensity under the resonance line. As the plasma becomes more opaque, changes in the line shape are observed. These are compared with computations.

1442

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SPIN-PHONON INTERACTION IN PARAMAGNETIC CRYSTALS, by R. D. Mattuck and M. W. P. Strandberg. Oct. 19, 1959 [14]p. incl. illus. diagrs. table, refs. (Technical rept. no. 357) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 246278 Unclassified

Also published in Phys. Rev., v. 119: 1204-1217, Aug. 15, 1960.

A general theory of the spin-phonon interaction, which is applicable to any iron group spin not in an S state, is developed. The theory employs a perturbation treatment that has a more direct physical meaning than techniques previously used and that leads to more accurate results. These results are presented in the form of an equivalent spin-phonon interaction Hamiltonian involving sums over products of spin operators and phonon creation-annihilation operators. The interaction between any two spin levels can then be calculated by using the spin wave functions associated with usual "spin Hamiltonian". It is shown that, owing to the dominant role played by the quadratic term in the above interaction, odd half-integer iron group spins ($S > \frac{1}{2}$) obey quadrupole selection rules. A formula is derived for order-of-magnitude calculations of the interaction strength. It is shown that acoustic experiments should provide the ideal way to test this theory in detail, and two methods of checking the quadrupole rule are proposed. Experimental results are reported on observed acoustic saturation in magnesium oxide doped with chromium ions, on the absence of saturation between low-field Kramers doublets in ruby, and an apparent saturation effect in F-center quartz. (Contractor's abstract)

1443

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SURVEY OF FERROMAGNETIC RESONANCE IN SMALL

FERROMAGNETIC ELLIPSOIDS, by F. R. Morganthaler. [1959] [3]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108])
Unclassified

Presented at Fifth Conf. on Magnetism and Magnetic Materials, Detroit, Mich., Nov. 16-19, 1959.

Published in Jour. Appl. Phys., Suppl., v. 31: 95S-97S, May 1960.

The response of the magnetism in a small ferromagnetic ellipsoid is considered. The generalized Kittel frequency for small amplitude excitation is given as: $\omega_o^2 = \gamma^2 \mu_o^2 [[H_o - (z-x)M] \times [H_o - (z-y)M] - W^2 M^2]$, where $x = N_x \sin^2\beta + N_y \cos^2\beta$, $Y = (N_x \cos^2\beta + N_y \sin^2\beta)\cos^2\alpha + N_z \sin^2\alpha$, $Z = (N_x \cos^2\beta + N_y \sin^2\beta) \sin^2\alpha + N_z \cos^2\alpha$, $W = \frac{N_x - N_y}{2} \cos\alpha \sin 2\beta$, N_x, N_y, and N_z are demagnitizing factors for the principal directions, and H_o is any value of magnetic field sufficient to magnetize the sample. If the ellipsoid is magnitized at an angle to the principle axis, time-varying components of demagnetizing field occur in the longitudinal direction, as well as transverse components varying at this frequency. Subharmonics as well as harmonics may be created when the driving field exceeds a certain threshold power. The particular case of the half-frequency is discussed along with the conditions for the minimum threshold. The generalized Suhl spin-wave spectrum is found to be $\omega_k^2 = \gamma^2 \mu_o^2 (H_o - ZM\cos\Theta + \lambda k^2 M \cos\Theta) \times (H_o - ZM\cos\Theta + \lambda k^2 M \cos\Theta + \sin^2\psi M \cos\Theta)$ if $|\cos\Theta| \simeq 1$, where λ is an exchange parameter, ψ is the angle the spin-wave vector makes with the z' axis, k is the spin-wave number and Z is the effective demagnetizing factor. The Suhl first and second order instability thresholds, for the general ellipsoid, are formulated, and a zero coupling is established for certain transient plates of the magnetism.

1444

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

COMMENTS ON MICROELECTRODES, by R. C. Gesteland, B. Howland and others. [1958] [7]p. incl. diagrs. refs. (In cooperation with Massachusetts Inst. of Tech. Lincoln Lab., Cambridge) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-76108] and Bell Telephone Labs., Inc.)
Unclassified

Published in Proc. Inst. Radio Engineers, v. 47: 1856-1862, Nov. 1959.

A comparison has been made between metal and fluid electrodes. The signal-to-noise ratio for high frequencies is extremely poor for the fluid tips, even with compensation, and extremely good for the spongy metal tip. As expected, the fluid tip is superior to the metal tip at low frequencies. (Contractor's abstract, modified)

1445

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A MODEL AND AN HYPOTHESIS FOR LANGUAGE STRUCTURE, by V. H. Yngve. [1959] [23]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108] and National Science Foundation) AD 248375
Unclassified

Presented at Autumn General Meeting of the Amer. Philos. Soc., Philadelphia, Pa., Nov. 1959.

Also published in Proc. Amer. Philos. Soc., v. 104: 444-466, Oct. 1960. (Title varies)

A more detailed discussion of a symposium presentation (item no. 1476) on a model for sentence production, consisting of a grammar containing rules for a particular language and a mechanism which is applicable to any language is explained. In addition, the following hypothesis has been proposed to test the observable effect of depth limitation in English grammar: Although all languages have a grammar based on constituent structure, the sentences actually used in the spoken language have a depth that does not exceed a certain number equal or nearly equal to the span of immediate memory (presently assumed to be 7 ± 2). The grammars of all languages include methods for restricting regressive constructions so that most sentences do not exceed this depth, and they include alternate constructions of lesser depth that would maintain the power of expression of the language. For all languages, much of the grammatical complexity over and above the minimum needed for the signaling function can be accounted for on this basis. When language change, depth phenomena will frequently be involved, and will often play an important role.

1446

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

CESIUM PLASMA (Abstract), by R. B. Hall and G. Bekefi. [1959] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108])
Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Dec. 3-5, 1959.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 314, Apr. 25, 1960.

Following a suggestion of N. Rynn, a steady-state plasma of high degree of ionization was produced by directing a beam of cesium atoms at a hot tungsten surface and removing the ions thus produced by a voltage applied between this surface and a second electrode. A dc magnetic field of 1200-2400 gauss reduced the diffusion loss of ions to the walls of the glass envelope. A section of the envelope close to the cesium oven was maintained at -78°C and reduced the vapor pressure in the rest of the system to less than 10^{-6} mm Hg. An ion current density of 5 ma cm^{-2} was obtained with a dc field of 4 v cm^{-1} and at a filament temperature of 2100°C. The cesium oven, with an aperture of 0.17 cm diam, was kept at 250°C. From the current-voltage characteristic, the ion density was estimated to be between 2×10^{10} cm^{-3} and 3×10^{11} cm^{-3}. The electron density calculated from the frequency shift of a microwave cavity was approximately 5×10^{10} cm^{-3}. Thus the degree of ionization was in excess of 50%.

1447

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

PLASMA ELECTRON WAVE SURFACES (Abstract), by W. P. Allis and R. J. Papa. [1959] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108] Atomic Energy Commission, National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Dec. 3-5, 1959.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 321, Apr. 25, 1960.

A plane electromagnetic wave splits into 2 different polarizations when propagating in a cold plasma in a magnetic field. The resonances and cutoffs for these waves were discussed at the Gatlinburg meeting (Apr. 27-28, 1959) and all types of wave-normal surfaces were shown. In a hot plasma a plane wave splits into 3 of differing polarizations and the third wave, whose velocity is of the order of a sound wave, will be termed "plasma wave". The wave surfaces of the plasma waves will be shown for wave frequencies well above ion cyclotron frequency. Their polarization, which is longitudinal only in special cases, and their relation to plasma oscillations, will be discussed.

1448

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

GENERAL THEORY OF THE PLASMA DIODE ENERGY CONVERTER, by W. B. Nottingham. [1959] [20]p. incl. diagr. tables. (Bound with its Tech. rept. no. 373; AD 246120) (Sponsored jointly by Air Force Office of Scientific Research, ffice of Naval Research, and Signal Corps under [DA 36-039-sc-78108])
AD 246120 Unclassified

Also published in Report on the Nineteenth Ann. Conf. on Physical Electronics, Massachusetts Inst. of Tech., Cambridge, 1959, p. 71.

The introduction of cesium into a thermionic device improves the emission capability of the emitter and the conduction properties of the space between the emitter and the collector. It also lowers the work-function of the collector. It is shown that under suitable conditions, a positive ion space-charge sheath forms in the immediate neighborhood of the emitter and, as a result of this space-charge situation electrons are accelerated from the emitter into the intervening space. Because the concentrations of ions and electrons are practically equal, plasma oscillations develop and the energy distribution of the electrons changes from a mono-energetic one associated with an energy of the order of 0.5 v or more, to a quasi-Maxwell-Boltzmann distribution characterized by a temperature of 5000°K, or more. Such an electron distribution is sufficiently rich in high-energy electrons to ionize the gas and maintain it in a state of practically 100% ionization. (Contractor's abstract)

1449

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

INTERPRETATION OF RESPONSES TO REPETITIVE ACOUSTIC STIMULI (Abstract), by M. H. Goldstein, Jr., N. Y.-S. Kiang, and W. T. Peake. [1959] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Proc. Third Internat'l. Cong. on Acoustics, Stuttgart (Germany), 1959, Amsterdam, Elsevier, v. 1: 60, 1961.

As the repetition rate of acoustic stimuli is increased there is generally a decrease in the amplitude of the potential that gross electrodes record from structures in the auditory pathways. This decrease in amplitude with increased repetition rate can be the consequence of several, not mutually exclusive, circumstances: (1) fewer neural units respond (fire) to each stimulus in the train of repetitive stimuli; (2) the potentials that the firing units contribute to the gross electrode response overlap; and (3) the firing of the units becomes

desynchronized. Responses from the auditory system to repetitive stimuli will be discussed in terms of a simple mathematical model that attempts to account for the above-mentioned effects. (Contractor's abstract)

1450

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

RESPONSES OF THE AUDITORY NERVE TO REPETITIVE ACOUSTIC STIMULI (Abstract), by W. T. Peake, N. Y.-S. Kiang, and M. H. Goldstein, Jr. [1959] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108])
Unclassified

Published in Proc. Third Internat'l. Cong. on Acoustics, Stuttgart (Germany), 1959, Amsterdam, Elsevier, v. 1: 60, 1961.

Responses to repeated bursts of noise and to sinusoidal stimuli were recorded from the auditory nerve of anesthetized and unanesthetized (encephale isolé) cats. The responses were recorded by means of (a) monopolar gross electrodes placed near the round window and (b) by concentric electrodes in the nerve. The problem under investigation is: the extent that the whole nerve "follows" repetition rate in the sense of exhibiting electrical responses to each repetition of the stimulus. An average response computer (ARC-1) was used to detect small neural responses and to minimize the microphonic components of the recorded response. (Contractor's abstract)

1451

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

TOWARD A MODEL FOR SPEECH RECOGNITION, by K. N. Stevens. [1959] [9]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Jour. Acoust. Soc. Amer., v. 32: 47-55, Jan. 1960.

An approach to the design of a machine for the recognition and synthesis of speech is proposed, with particular emphasis on problems of acoustical analysis. As a recognizer, the machine accepts a speech wave at its input and generates a sequence of phonetic symbols at its output. As a synthesizer, it accepts a sequence of symbols at its input and generates a speech wave. Coupling between the acoustical speech signal and the machine is achieved through an analog filter set or equivalent and a model of the vocal tract. Each stage of analysis is performed by synthesis of a number of alternative signals or patterns according to rules stored within the machine and by comparison of the synthesized patterns with the input signals that are under analysis. (Contractor's abstract)

1452

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

OPERATING CHARACTERISTICS OF A MOLECULAR-BEAM MASER, by H. G. Venkates and M. W. P. Strandberg. [1959] [4]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and the Ministry of Education, Government of India and the Indian Institute of Technology)
Unclassified

Published in Jour. Appl. Phys., v. 31: 396-399, Feb. 1960.

General expressions for the emitted power and the frequency pulling in an ammonia maser have been deduced. The operating characteristics of the maser have been deduced by introducing a mean square time of flight of molecules in the cavity. (Contractor's abstract)

1453

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PHOTOELECTRIC YIELD FROM ADSORBED GAS LAYERS IN THE SOFT X-RAY REGION, by K. R. Dawber. [1959] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108])
Unclassified

Published in Rev. Scient. Instr., v. 31: 210-211, Feb. 1960.

A 10-stage assembly is mounted without envelope in a vacuum system containing a 200-300A x-ray source (Al target) in order to study the operation of Allen-type Be-Cu photomultipliers in the soft x-ray region. The arrangement enables the multiplier to be operated immediately after heat treatment has ceased. The yields of Be-Cu, Cu, stainless steel, etc. are obtained as a function of temperature, pressure, and time after firing. More versatility can be achieved by making the photosensitive first plate of the multiplier interchangeable. The results show that the yield from clean metal or alloy surfaces is negligible in comparison with that from the adsorbed gas. In the case with Cu, oxygen-free high-conductivity Cu is found to form the most stable and thickest adsorbed gas layer above certain pressure. It is concluded that this method offers a

new way of studying gas adsorption. Time variations in yield at constant temperature are noted only at pressures below 1.5×10^{-5} mm Hg and show no reproducibility.

1454

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

WHAT IS A NUMBER, THAT A MAN MAY KNOW IT, AND A MAN, THAT HE MAY KNOW A NUMBER? by W. S. McCulloch. [1959] [12]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], National Institutes of Health, and Teagle Foundation) Unclassified

Presented at Ninth Annual Alfred Korzybski Memorial Meeting, New York, Mar. 12, 1960.

Published in Gen. Seman. Bull., no. 26: 7-18, 1960.

Recent experimental and conceptual advances in neurology are discussed. Particular emphasis is placed upon the discriminating, generalizing, and abstracting processes of humans and their relation to computers and artificial organisms.

1455

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

INTRODUCTION TO SOFT X-RAY SPECTROSCOPY, by E. R. Pike. [1959] [8]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Amer. Jour. Phys., v. 28: 235-242, Mar. 1960.

The presentation of some fundamental ideas concerning the behavior of electrons in solids is followed by an outline of the theory of the use of x-ray methods for obtaining information about these electrons. Experimental methods are discussed briefly and some recent trends and developments in the subject are reviewed. (Contractor's abstract)

1456

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A DOPPLER-CANCELLATION TECHNIQUE FOR DETERMINING THE ALTITUDE DEPENDENCE OF GRAVITATIONAL RED SHIFT IN AN EARTH SATELLITE, by R. S. Badessa, R. L. Kent and others. [1959] [7]p. incl. diagrs. table, refs. (Sponsored jointly by [Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108]. and the National Aeronautics and Space Administration) Unclassified

Published in Proc. Inst. Radio Engineers, v. 48: 758-764, Apr. 1960.

A cancellation technique permits measurement of the frequency of a source moving relative to an observer without the obscuring effect of first-order Doppler shifts. The application of this method to a gravitational red shift experiment involving the use of an earth satellite containing a highly stable oscillator is described. The rapidity with which a measurement can be made permits the taking of data at various altitudes in a given elliptical orbit. Tropospheric and ionospheric effects upon the accuracy of results are estimated. (Contractor's abstract)

1457

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MOLECULAR TRAJECTORIES IN ELECTRIC FIELDS AND STATE SELECTION IN A BEAM OF SODIUM CHLORIDE, by M. Peter, H. G. R. Venkates, and M. W. P. Strandberg. [1959] [4]p. incl. illus. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 241047 Unclassified

Published in Jour. Appl. Phys., v. 31: 696-696, Apr. 1960.

A molecular beam of sodium chloride can be partially sorted with respect to the rotational levels of the molecule when it is passed through an inhomogeneous electric field. The possibility of state selection of the beam in one of the lower rotational states of the molecule ($J = 2$; $|M| = 0, 1, 2$) has been investigated by studying the molecular trajectories for the rotational states $J = 1$; $|M| = 1, 0$ and $J = 2$; $|M| = 2, 1, 0$. A typical calculation for a state selector is given. (Contractor's abstract)

1458

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

PAIN, ITCH, AND VIBRATION, by P. D. Wall and J. R. Cronly-Dillon. [1959] [11]p. incl. illus. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], Bell Telephone Labs., Inc., Public Health Service, and Teagle Foundation) AD 240862 Unclassified

Also published in A. M. A. Arch. Neurol., v. 2: 365-375, Apr. 1960.

The organization of a system of cells lying in the dorsal part of the dorsal horn of the cat was examined. The cells belonging to the system were found to respond to both light and heavy skin pressure, as well as to skin temperature change. Furthermore, the response of these cells to peripheral skin stimuli indicates that primary afferent fibers converge on them and that the temporal pattern of discharge of these units varies with the type of stimulus applied to the skin. Damage to the receptive field of a cell or the application of an itch-producing substance, cowhage, produces a characteristic bursting discharge of the cells. It is suggested that the pattern of firing of these common-carrier cells determines the modality-specific responses in subsequent parts of the nervous system. The unusual pattern of afferent impulses, set up by light vibration of the skin, interferes with the response of these cells to touch, damage, itching compounds and temperature. When the same vibration is applied to the skin in man, the threshold for the perception of touch, pain, and temperature is raised. The evidence suggests that the apparently separate modalities of skin sensation may result from the filtering properties of cell groups in the sensory system rather than from the existence of anatomically separate pathways for each modality. (Contractor's abstract)

1459

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NOISE SPECTRUM OF PHASE-LOCKED OSCILLATORS, by M. W. P. Strandberg. [1959] [2]p. incl. illus. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Proc. Inst. Radio Engineers, v. 48: 1168-1169, June 1960.

The results are summarized at the termination of the project on the study of the sources of noise in phase-locked oscillators. It is concluded that with reasonably decent feedback electronics, the noise arising from the fundamental crystal oscillator or the multiplier chain is negligibly small, even with a frequency multiplication ratio of 10,000. Although the system is far from optimum, with low IF frequency and limited locking range of less than 0.5 mc, the feasibility of phase-locking techniques are sufficient for most purposes.

1460

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SOLUTION OF AN INTEGRAL EQUATION OCCURRING IN MULTIPATH COMMUNICATION PROBLEMS, by T. Kailath. [1959] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Also published in I.R.E. Trans. on Information Theory, v. IT-6: 412, June 1960.

The equation to be solved is $\rho(t, \tau) = \int_0^T h(x,t)h(x,\tau)dx$, $0 \leq t, \tau \leq T$, where $\rho(t, \tau)$ is a known symmetrical positive-definite function, and the h(x, t) is the unknown to be determined. The problem had been solved by D. Middleton (see I.R.E. Trans. on Information Theory, v. IT-3: 85-121, 1957) and its erratum was discussed (I.R.E. Trans. on Information Theory, v. IT-6: 349-360, 1960). Some other methods of solution are briefly described. In some cases, more practical answers are obtained.

1461

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NOISE REDUCTION IN ELECTRON BEAMS, by A. Zacharias and L. D. Smullin. [1959] [2]p. incl. diagrs. table. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in I.R.E. Trans. on Electron Devices, v. ED-7: 172-173, July 1960.

Direct measurements were made of the electron-beam noise parameters using a modified Curie-type gun. The noise parameters were measured as a function of the electric field in the vicinity of the cathode. The S parameter was strongly influenced by this field in the Curie-type gun, but the parameter Π/s was relatively unaffected. (Contractor's abstract)

1462

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ENCODING AND ERROR-CORRECTION PROCEDURES FOR THE BOSE-CHAUDHURI CODES, by W. W. Peterson. [1959] [12]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in I.R.E. Trans. on Information Theory, v. IT-6: 459-470, Sept. 1960.

Bose and Ray-Chaudhuri have recently described a class of binary codes which for arbitrary m and t are t-error correcting and have length $2^m - 1$ of which no

more than mt digits are redundancy. A simple error-correction procedure for these codes is described. Their cyclic structure is demonstrated and methods of exploiting it to implement the coding and correction procedure using shift registers are outlined. Closer bounds on the number of redundancy digits are derived. (Contractor's abstract)

1463

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

VARIATIONAL PRINCIPLES AND MORE COUPLING IN PERIODIC STRUCTURES, by T. J. Goblick, Jr. and R. M. Bevensee. [1959] [10]p. incl. illus. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 250493 Unclassified

Also published in I.R.E. Trans. on Microwave Theory and Tech., v. MIT-8: 500-509, Sept. 1960.

Variational techniques are used in analyzing periodic cold microwave structures for the angular frequency as a function of assumed phase shift per periodic cell. (Contractor's abstract)

1464

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DECISION PROCESSES IN PERCEPTION, by J. A. Swets, W. P. Tanner, Jr. and T. C. Birdsall. [1959] [40]p. incl. diagrs. refs. (Technical rept. no. ESD-TR-61-20) (In cooperation with Michigan U., Ann Arbor) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Psychol. Rev., v. 68: 301-340, Sept. 1961.

A brief review of the theory of statistical decision is presented followed by a description of the elements of the theory of signal detection appropriate to human observers. The results of some experimental tests of the applicability of the theory to the detection of visual description are described.

1465

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A COMPARISON OF FM DEMODULATION METHODS, by E. J. Baghdady. [1960] [24]p. incl. illus. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at Sixth annual meeting of the Amer. Astronaut. Soc., New York, Jan. 18-21, 1960.

Published in Advances Astronaut. Sci., v. 6: 3-26, 1961.

The problem of receiving FM signals that fall below the conventional random noise threshold is becoming increasingly important in various areas of communication. This problem is covered in this report and a discussion is presented for the various techniques proposed to receive weak signals. In particular, the uses of lock oscillators, oscillating limiters, feedback to compress the frequency range occupied by the signal, as well as the conventional limiter discriminator arrangement, are evaluated and compared. (Contractor's abstract)

1466

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

FM WEAKER-SIGNAL SUPPRESSION WITH NARROW-BAND LIMITERS, by R. J. McLaughlin. Feb. 1, 1960, 32p. incl. illus. tables. (Technical rept. no. 361) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 246280 Unclassified

A study has been made of the practical requirements in the design of FM receivers for suppressing cochannel interference by the method of narrow-band limiting. A design procedure specifying sufficient properties for each section of the receiver is presented. The amplitude disturbances that are caused by the interference before and after narrow-band limiting of the resultant signal are evaluated, in order to determine the limiting-threshold requirements for their suppression. The results of an extensive study of the potentialities of the gated-beam limiter are presented, and its suitability for use as a narrow-band limiter is discussed. The report on computational studies is accompanied by an experimental study of receiver performance, and an estimate is made of the effect of deviations of the properties of the various receiver stages from those assumed in ideal theoretical models.

1467

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DYNAMIC ANALOG SPEECH SYNTHESIZER, by G. Rosen. Feb. 10, 1960, 88p. incl. illus. diagrs. tables, refs. (Technical rept. no. 353) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

A dynamically controllable electrical analog of the vocal tract that is capable of synthesizing sequences of speech sounds is described. The acoustic transmission line between glottis and lips in the human vocal tract is

realized electrically by electronically controlled variable inductance-capacitance sections. Excitation is provided for simulating the glottal tone and the noise of turbulence. The synthesizer was conceived as an instrument for research on speech production and perception. Its control system is designed to permit the synthesis of any sequence of two phonetic elements, and provides precise, flexible control over many geometric and temporal variables. Exploratory formal listening tests were conducted, with idealized geometries for the vocal tract, and piecewise-linear functions were used for describing the timing relations. An articulation score of 93% was obtained for vowels made with a parabolic approximation to the tongue hump. Listeners were within 5% of unanimity in their identification of some fricatives in consonant-vowel syllables. At the phoneme boundary in these syllables, the tolerance for relative timing error between control signals is approximately 10-30 msec. Experimental evidence that strongly supports the viewpoint that the articulatory level provides a natural and economical description of speech is given. Thus, the dynamic analog is potentially capable of synthesizing highly natural connected speech from signals having a low information rate. (Contractor's abstract)

1468

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NONLINEAR SYSTEMS WITH GAUSSIAN INPUTS, by D. A. Chesler. Feb. 15, 1960, 76p. incl. diagrs. table, refs. (Technical rept. no. 366) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 256495 Unclassified

Methods are developed for optimizing a general multi-input, single-output, nonlinear system whose inputs are Gaussian processes. The output of the nonlinear system is expressed as a sum of orthogonal functional polynomials of the inputs. The only statistical information needed for this optimization is composed of the first-order autocorrelations and crosscorrelations among the inputs, and the higher-order crosscorrelations between the inputs and the desired output. Methods are developed also for optimizing simple single-input nonlinear systems whose input is Gaussian. The systems consist of combinations of linear systems and nonlinear no-memory devices. The systems have a fixed form with some undetermined parameters. The system is optimized by making an optimum choice of the values of these parameters. Methods are presented for determining these optimum values by measurements. (Contractor's abstract)

1469

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

AN ANALYTICAL STUDY OF ELECTRIC RESPONSES AT THE PERIPHERY OF THE AUDITORY SYSTEMS, by W. T. Peake. Mar. 17, 1960, 62p. incl. diagrs. refs. (Technical rept. no. 365) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 247611 Unclassified

Acoustic stimuli, especially if they are impulsive in nature, give rise to well-defined neuroelectric events in the auditory nerve of many animal species. In this research, the summated action potentials of the cat's auditory nerve were recorded with gross electrodes from locations in the vicinity of the cochlea. This report is primarily concerned with the analytic study of the behavior of these neural potentials in relation to changes in stimulus parameters. In order to investigate possible relations between the neural and the cochlear microphonic potnetials, electrical activity was recorded in cats whose auditory nerve had degenerated. Characteristics of the microphonic response to clicks were determined. A "slow" potential that does not reverse with stimulus polarity as the microphonic does was discovered. Neural responses to condensation and rarefaction clicks were observed over a wide range of stimulus intensity; it was found that the differences between the responses to the two-click polarities depend on the intensity. These differences can be interpreted in terms of two excitatory processes, one of which can be related to the microphonic potential, and the other seems to be related to the "slow" potential. Neural responses to impulsive stimuli were studied as a function of stimulus repetition rate. For moderate intensities, the amplitude of the neural response begins to decrease for rates higher than 10/sec. Stimulus-locked neural activity can be detected in averaged responses up to rates of nearly 3000/sec. The effect of overlapping of response waveforms is described in terms of a mathematical model. (Contractor's abstract)

1470

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

AN APPROACH TO THE SYNTHESIS OF LINEAR NETWORKS THROUGH USE OF NORMAL COORDINATE TRANSFORMATIONS LEADING TO MORE GENERAL TOPOLOGICAL CONFIGURATIONS, by E. A. Guillemin. [1960] [9]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at I.R.E. Internat'l. Convention, New York, Mar. 21-24, 1960.

Published in I.R.E. Trans. on Circuit Theory, v. CT-7: 40-48, Aug. 1960.

Also published in I.R.E. Internat'l. Convention Record, Part 2: 171-179, 1960.

The proposed procedure presents a method of

determining parameter matrices from given impedance functions through use of normal coordinate transformations, and realizes the pertinent network by identical tree configurations in single-element-kind networks having a general topological structure. Essentially the same procedure is applicable to passive bilateral networks and to non-passive and/or non-bilateral ones, differing only in the appropriate normal coordinate transformation. Although tedious computations are involved, the availability of modern computers makes this method feasible and thus opens up a more general and potentially useful approach to network synthesis. (Contractor's abstract)

1471

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

ELECTRIC FIELD DEPENDENCE OF THE IMPACT IONIZATION PROBABILITY OF GROUP V DONORS IN n-TYPE GERMANIUM (Abstract), by S. C. Brown and G. Ascarelli. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 194, Mar. 21, 1960.

The time interval elapsed between the instant a "breakdown" field is applied to a germanium sample and the instant the electron density reaches an arbitrary preset value is measured as a function of the applied dc field. It is shown that this time interval is proportional to the time constant describing the rate of change of the electron density. It is found that the time constant varied proportionally to $E^{-1}(E - E_B)^{-1}$, where E_B is the value of the breakdown field corresponding to a very long time interval (of the order of milliseconds). Under some reasonable simplifying assumptions, it is shown that the probability of impact ionization should be proportional to $E(E - E_B)$.

1472

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ABRACADABRA, by W. S. McCulloch. [1960] [12]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Mental Patients in Transition, Conf., Boston, Mass. (Mar. 24-26, 1960), Springfield, Charles C. Thomas, Publisher, 1961, p. 359-370.

A logic which is suited to the circuit theory of brains is analyzed. The historical development of this branch of psychiatry is presented with special recommendations for future research.

1473

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

ON THE NOTION "RULE OF GRAMMAR", by N. Chomsky. [1960] [19]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108] and National Science Foundation) AD 258922 Unclassified

Also published in Structure of Language and Its Mathematical Aspects, Proc. Twelfth Symposium in Appl. Math., New York (Apr. 14-15, 1960), Providence, R. I., Amer. Math. Soc., v. 12: 6-24, 1961.

Grammatical theory is discussed with special emphasis placed upon the exact nature of a structural description. This theory provides a scheme and notation for grammatical description, and makes it possible to determine what a grammar states about particular sentences without exercise of intuition.

1474

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ON THE FORMALIZATION OF HANDWRITING, by M. Eden. [1960] [6]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 258924 Unclassified

Also published in Structure of Language and Its Mathematical Aspects, Proc. Twelfth Symposium in Appl. Math., New York (Apr. 14-15, 1960), Providence, R. I., Amer. Math. Soc., v. 12: 63-88, 1961.

Cursive English handwriting is studied by means of a set of strokes and segments. Each stroke is a real number and a pair of points, the points being ordered in at least 1 of 2 (not necessarily orthogonal) coordinates. The strokes are generated from a subset of 4 strokes (bar, hook, arch, and loop) called segments. Associated with each stroke is a direction. If for any s_j, $[(\beta_{j2} - \beta_{j1}) \times \theta_j] > 0$, then the initial direction, $\theta_{j1} = \Pi/2$ and is read "the initial direction is up". Otherwise, $D_{j1} = -(\Pi/2)$, i.e., "down". The final direction $D_{j2} = (D_{j1} + \theta_j) \pmod{2\Pi} < \beta_{j2}$, β_{j1}, and θ_j refer to the individual segments.

1475

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

ON THE ROLE OF SIMPLICITY IN LINQUISTIC DESCRIPTIONS, by M. Halle. [1960] [6]p. incl. tables. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108] and National Science Foundation) AD 258923 Unclassified

Also published in Structure of Language and Its Mathematical Aspects, Proc. Twelfth Symposium in Appl. Math., New York (Apr. 14-15, 1960), Providence, R. I., Amer. Math. Soc., v. 12: 89-94, 1961.

The phonological aspects of dialect vs standard language are studied. In addition, Grimm's and Verner's laws are analyzed in relation to the evolution of the Germanic languages.

1476

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

THE DEPTH HYPOTHESIS, by V. B. Yngve. [1960] [9]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and signal Corps under [DA 36-039-sc-78108] and National Science Foundation) AD 258921 Unclassified

Also published in Structures of Language and Its Mathematical Aspects; Proc. Twelfth Synposium in Appl. Math., New York (Apr. 14-15, 1950), Providence, R. I., Amer. Math. Soc., v. 12: 130-138, 1961.

An explanation for many of the previously unexplained features of the English syntax is presented as a supplement to a more detailed account (see item no. 1445, Vol. IV). The depth hypothesis states that much of the syntactic complexity of English can be understood in terms of the memory restriction which shows that only seven grammatical or syntactic constraints, or only seven digits, nonsense words or items can be remembered at one time. The way in which a limited memory can affect the syntactic structure of a language can be understood on the basis of a simple model of sentence production. This model can be easily programmed on a computer so that a set of phase-structure rules which give the immediate constituents for every constructure in the language can be applied.

1477

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

GENERALIZATION OF THE FREQUENCY-POWER FORMULAS OF MANLEY AND ROWE, by P. Penfield, Jr. [1960] [27]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108; and Wright-Patterson Air Force Base) Unclassified

Published in Active Networks and Feedback Systems, Proc. of the Symposium, New York (Apr. 19-21, 1960) Brooklyn, Polytechnic Press, v. 10: 387-413, 1961. (AFOSR-718)

It is interesting to inquire what physical systems obey the Manley-Rowe frequency-power formulas. Surprisingly, losslessness is neither a necessary nor a sufficient condition. However, systems characterized by a (possibly explicitly time-varying) energy state function, such as the Lagrangian, Hamiltonian, internal energy, or co-energy obey the formulas. Distributed sytems described by Hamilton's principle obey the formulas in such a way that the powers can be evaluated at the boundaries of the systems. The formulas thus relate quantities of engineering interest: the powers through the ports. Such distributed systems include nonlinear electromagnetic media, ferrites, electron beams, and acoustic fields. (Contractor's abstract)

1478

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

TOPOLOGY AND LINEAR TRANSFORMATION THEORY IN ACTIVE NETWORK SYNTHESIS, by E. A. Guillemin. [1960] [13]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Active Networks and Feedback Systems, Proc. of the Symposium, New York (Apr. 19-21, 1960), Brooklyn, Polytechnic Press, v. 10: 457-474, 1961. (AFOSR-718)

Linear transformation theory is used to devise a method of parameter matrix construction from a specified rational response function. Realization of this function is achieved through use of topology with a single-element-kind realization (technique applied to the parameter matrices thus found. The result offers an approach to the synthesis of active and/or nonbilateral networks since the parameter matrices may be dissymmetrical and pertinent to nonpositive energy forms as well as to passive bilateral networks. Advantage over other methods lies chiefly in the complete generality of topological configurations obtainable and in the controllability of element value distributions. (Contractor's abstract)

1479

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE AVERAGE RESPONSE COMPUTER (ARC): A

DIGITAL DEVICE FOR COMPUTING AVERAGES AND AMPLITUDE AND TIME HISTOGRAMS OF ELECTRO-PHYSIOLOGICAL RESPONSE, by W. A. Clark, R. M. Brown and others. [1960] [6]p. incl. illus. diagrs. (In cooperation with Massachusetts Inst. of Tech., Lincoln Lab., Cambridge) (Sponsored jointly by Air Force [Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78106]) Unclassified

Presented at Twelfth Southwestern I.R.E. and Nat'l. Professional Group on Bio-Medical Electronics Conf., Houston, Tex., Apr. 20-22, 1960.

Published in I.R.E. Trans. of Bio-Medical Elec., v. BME-8: 46-51, Jan. 1961.

The average response computer has proved a valuable tool for measuring statistics of neuroelectric activity, particularly of evoked responses. The instrument is capable of operating "on line," permitting observation and modification on the basis of the calculated results while the experiment is in progress.

1480

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

HYPERFINE STRUCTURE OF Hg^{199}: AN APPLICATION OF THE LEVEL-CROSSING TECHNIQUE (Abstract), by H. R. Hirsch. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 274, Apr. 25, 1960.

The level crossing technique of Colgrove, Franken, Lewis, and Sands has been applied to the hyperfine structure of Hg^{199}. Light of 2537A which is scattered at right angles decreases sharply at a field of 7095 gauss. This value leads to a magnetic dipole interaction constant, A, of 14,743 ± 15 mc. The limit of error depends upon knowledge of the electronic g factor and of the field. The result of the present work is to be compared with the A value that C. Stager obtained by a direct rf resonance: 14,752.37 ± 0.02 mc.

1481

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

HYPERFINE STRUCTURE OF Hg^{199} AND Hg^{201} IN THE $^3P_1$ STATE (Abstract), by C. Stager and R. Kohler. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 274, Apr. 25, 1960.

The hyperfine structure splittings of the $^3P_1$ state by paramagnetic resonance using optical detection have been measured. The technique used is a modification of the "double resonance" experiment of Bitter and Brossel in that selective absorption of certain hfs levels, rather than change in polarization, is used to detect the resonance. The results are: Hg^{199}: $\Delta\nu$ = 22,128.56 ± 0.02 mc; Hg^{201} (H = 5/2 to 3/2): 13,986.557 ± 0.008 mc; (F = 3/2 to 1/2) 7551.613 ± 0.013 mc. Combining these data with the magnetic moment values, the Bohr-Weisskopf effect is calculated. It is found that $\Delta(^3P_1)$ = 0.1637(23)%, as compared with $\Delta(^3P_2)$ = -0.1728(12)% (McDermott), and Δ(Knight shift) = -0.16% (Eisinger et al). The value of Δ does not include electronic corrections.

1482

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

MEASUREMENT OF THE ATOMIC g VALUE OF Hg^{202}, Hg^{199}, AND Hg^{201} IN THE 6^3P_2 STATE (Abstract), by B. B. Aubrey and L. C. Bradley, III. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 274, Apr. 25, 1960.

Hg atoms were excited to the metastable 6^3P_2 state by unidirectional electrons in a planar diode containing Hg vapor at low pressure. The alignment was monitored by the absorption of polarized λ 5461 radiation from an Hg^{198} lamp in a "scanning" magnetic field, which permitted the selection of a particular hfs component to be studied. Transitions between the Zeeman sublevels of $^3P_2$ state were induced by a radiofrequency field (50 mc/sec) of a few milligauss. Resonances were obtained in the even isotopes, the F = 5/2 and F = 3/2 levels of Hg^{199}, and the F = 7/2 and F = 5/2 levels of Hg^{201}. The g values for the resonances are:

Even isotopes: $gJ = 1.5007 \pm (4)$

Hg^{199}: $F = 5/2$; $gF = 1.1997 \pm (5)$

$F = 3/2$; $gF = 1.7993 \pm (11)$

Hg^{201}: $F = 7/2$; $gF = 0.85706 \pm (80)$

$F = 5/2$; $gF = 0.9424 \pm (12)$.

The line widths in all cases were a few hundred kilocycles and are believed to be mainly due to magnetic field inhomogeneity.

1483

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

RECURSIVE FUNCTIONS OF SYMBOLIC EXPRESSIONS AND THEIR COMPUTATION BY MACHINE, I, by J. McCarthy. [1960] [12]p. incl diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108] and Alfred P. Sloan Foundation) Unclassified

Presented at Conf. on Symbol Manipulation, Pennsylvania U., Philadelphia, May 20-21, 1960.

Published in Comm. Assoc. Computing Mach., v. 3: 184-195, Apr. 1960.

A formalism which has advantages as a programming language and a vehicle for developing a theory of computation is described. S-expressions and S-functions are considered along with the universal S-function apply which plays the theoretical role of a universal Turing machine and the practical role of an interpreter. The representation of S-expressions in the memory of the IBM 704 by list structures similar to those used by Newell, Shaw, and Simon and the representation of S-functions by program are discussed. The main features of the LISP (LISt Processor) programming system for the IBM 704 are mentioned along with a method for describing computations with symbolic expressions. Finally, a recursive function interpretation of flow charts is given.

1484

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

A BINARY ALGEBRA DESCRIBING CRYSTAL STRUCTURES WITH CLOSELY PACKED ANIONS. PART II: A COMMON SYSTEM OF REFERENCE FOR CUBIC AND HEXAGONAL STRUCTURES, by I. L. Morris and A. L. Loeb. [1960 [10]p. incl. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 240917 Unclassified

Published in Acta Cryst., v. 13: 434-443, May 10, 1960.

In the cubic crystals of the rocksalt, sphalerite, antifluorite, and spinel types and in the hexagonal crystals of the nickel arsenide, wurtzite, and olivine types, the cations are either octahedrally or tetrahedrally surrounded. Algorithms are presented for locating the ions of these seven structures in the following sequence. First, cubically and hexagonally closely packed anion structures are compared, and geometric operators relating the two classes are defined. Second, the location of all possible cation sites is described algebraically, and finally the distribution of cations over these sites is described in terms of the parities of the coordinates of the sites. An interstitial type of crystal model from which the seven classes of crystals have been constructed is discussed. (Contractor's abstract)

1485

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MOVEMENT OF THE LIPS IN THE GENERATION OF BILABIAL CONSONANTS (Abstract), by O. Fujimura. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and National Science Foundation) Unclassified

Presented at Fifty-ninth meeting of the Acoust. Soc. Amer., Brown U., Providence, R. I., June 9-11, 1960.

Published in Jour. Accust. Soc. Amer., v. 32: 913, July 1960.

The movement of the lips during the pronunciation of bilabial stops and nasals in various contexts has been studied by means of a stroboscopic technique. A rate of 240 frames/sec was used for the major part of this study. The results show that, for initial [p], [b], and [m] when not followed by [r], the separation of the lips reaches about 30% of the max value in the following vowel, and the width of the mouth opening reaches about 50% only about 5 msec after the separation begins. It is predicted from the results that about half of the total traverse of the formant transitions might well occur within about 5 msec after the plosion. The speed of the motion depends on the context. It is markedly slower for [p] preceded by unaccented [e] than for initial [p]. An oscillatory tendency in the motion of the lips generally was observed after the plosion of the stops; this was particularly apparent when [p] was followed by [r]. The data suggest that the lips are blown apart by the air pressure behind the occlusion in the case of initial [p] and [b] but not in the case of [m].

1486

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SCATTERING OF SOUND BY SOUND (Abstract), by L.

W. Dean. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108])
Unclassified

Presented at Fifty-ninth meeting of the Acoust. Soc. Amer., Brown U., Providence, R. I., June 9-11, 1960.

Published in Jour. Acoust. Soc. Amer., v. 32: 934, July 1960.

The interaction of two sound beams traveling at right angles to each other is discussed. In the case of two perfectly collimated beams the solution is obtained by solving an inhomogeneous wave equation in the region of intersection, solving a homogeneous wave equation outside this region, and fitting the 2 solutions at the boundary. Scattered waves appear at various angles which are the same as the angles predicted by U. Ingard and D. C. Pridmore-Brown (Jour. Acoust. Soc. Amer., v. 28: 367, 1956). The generalization to cases where the boundary of the region of intersection of the two beams is not sharply defined is also discussed.

1487

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

ENERGY BALANCE IN A THERMONUCLEAR REACTOR (Abstract), by D. J. Rose. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and Atomic Energy Commission)
Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 367, June 15, 1960.

Energy flow and balance diagrams are presented for a D-T thermonuclear reactor, on the assumption that stability can be achieved. Presence of a neutron moderation blanket appears to preclude fast pulsed operation. For a magnetic mirror system, it is found: (a) the principal energy loss is by particles from the mirrors; (b) for reasonable energy conversion efficiencies, ion temperature $T_i \approx 100$ kev and mirror ration $R \approx 10$ are required; (c) it is probably necessary to remove the high-energy α particles quickly from the system; this is a difficult task; (d) a maximum magnetic induction ≈ 1.5 weber/m^2 exists in a long straight section of the mirror; (e) if superconducting solenoids at 1.5 weber/m^2 can be developed, the efficiency of the system can be improved considerably. Such solenoids do not appear technologically more difficult than supercooled normally conducting ones and offer considerable advantage within their limitation on the induction. Application of superconducting coils to the thermonuclear systems other than mirrors is discussed briefly.

1488

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

DIFFUSION AND HEAT CONDUCTION OF A WEAKLY IONIZED PLASMA IN A MAGNETIC FIELD (Abstract), by D. R. Whitehouse and G. Bekefi. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and Atomic Energy Commission)
Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 368, June 15, 1960.

Measurements of electron density and temperature in regions free from ionization and applied electric fields are used in the study of plasma transport properties. In the present experiment, a cylindrical plasma column is maintained at one end by an active discharge, and immersed in an axial dc magnetic field. The electron density is obtained from the loading of a microwave cavity and the electron temperature from the microwave noise emitted by the plasma. From the axial decay of density and temperature, the diffusion coefficient across the magnetic field and the coefficient of thermal conduction along the magnetic field can be inferred. In these calculations the dependence of diffusion and thermal conduction on the temperature can strongly influence the spatial variations. In particular, calculations show that, in the presence of a high magnetic field, the decay in temperature can be sufficiently fast to cause a local increase in electron concentration.

1489

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

MICROWAVE MEASUREMENTS OF PLASMA TEMPERATURE (Abstract), by G. Bekefi. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and Atomic Energy Commission)
Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 382, June 15, 1960.

The radiation temperature of the positive column of a glow discharge in helium and hydrogen was measured as a function of the current, the axial electric field E, and gas pressure p. The measurements were made for values of E/p from 1v to 50v cm^{-1} $mm\ Hg^{-1}$ and for currents between 10^{-3} and 1 amp. The results are

compared with calculations of the temperature of the positive column. The effect of an axial dc magnetic field on the temperature was studied for fields up to 2500 gauss. Measurements show that the anomalous increase of E at certain critical magnetic fields, which has been observed recently, is accompanied by an increase of the plasma temperature. The microwave noise radiation was detected at a frequency of 3000 mc. The plasma was illuminated by a blackbody source of known, variable temperature. The blackbody temperature was adjusted until the noise power received became independent of the presence of the unknown plasma. At this point, the temperature of the 2 radiators is the same, and the measurements are independent of the plasma emissivity.

1490

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

LINE PROFILES OF CYCLOTRON RADIATION (Abstract), by J. L. Hirshfield. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 383, June 15, 1960.

For a plasma in thermal equilibrium, the emission is obtained from the absorption via Kirchhoff's radiation law. For a transparent ($\omega p^2/\omega_b \nu_c << 1$), low-temperature [$(kT/mc^2)^{\frac{1}{2}} << \nu_c/\omega_b$] plasma, in which the damping of electromagnetic wave is governed chiefly by collisions, it has been shown previously that the line shape is Lorentzian for a constant collision frequency. The same result has been obtained from single-particle considerations. Experimental comparisons of line profiles with theory, covering a range of more than 4 half-widths, are presented. At lower collision frequencies and/or higher electron temperatures, when the electron's thermal motion can influence the wave damping, the absorption coefficient, as deduced from Sitenko and Stepanov's permittivity tensor, yields a Voigt profile for the emission, provided that $\omega p^2/\omega_b \nu_c << 1$. This also agrees with what one would infer from single-particle considerations. Experimentally observed line profiles at low-collision frequencies will be discussed.

1491

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

RECEIVING-ANTENNA INFLUENCE ON CYCLOTRON RADIATION MEASUREMENTS (Abstract), by S. Gruber. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 383, June 15, 1960.

The measured shape of a pressure-broadened line is modified by the length of time spent by an average electron within the region of observation. This effect becomes important at low pressures when the probability of an electron making a collision within the region of observation is small. The line shape as measured is determined by the length of time spent by an electron in the observation region and by the receiving-antenna pattern at the plasma. A relationship is derived for the power received as a function of frequency in terms of the probability distribution of collisions, the electron velocity distribution along the dc magnetic field, and the antenna pattern. An antenna pattern producing a one-to-one correspondence between the measured power spectrum and the electron velocity distribution is given. Experimental results obtained at a frequency of 8.2 kmc with an open waveguide used as the receiving antenna illustrate the effect.

1492

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ANALYSIS OF FIRING PATTERNS IN SINGLE NEURONS, by G. L. Gerstein. [1960] [2]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 241723 Unclassified

Published in Science, v. 131: 1811-1812, June 17, 1960.

The use of a high-speed digital computer for investigation of neural firing patterns is described. The high sensitivity of the method permits detection of stimulus-response relations buried in a background of spontaneous activity. (Contractor's abstract)

1493

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

TWO-WAY COMMUNICATION CHANNELS, by C. E. Shannon. [1960] [34]p. incl. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Also published in Proc. Fourth Berkeley Syposium on Mathematical Statistics and Probability, California U., Berkeley (June 20-July 30, 1960), Los Angeles, California U. Press, 1961, v. 1: 611-644. (AFOSR-2135)

It is shown that for a memoryless discrete channel there exists a convex region G of approachable rates. In addition, an inner and outer bound, G_I and G_O, are found. It is also shown that in certain important cases these bounds are identical so the capacity region is then completely determined from the bounds. The three regions G_I, G and G_O are all convex and have the same intercepts on the axes. These intercepts are the capacities in the two directions when the other input letter is fixed at its best value. For any point inside G the error probabilities approach zero exponentially with the block length n. For any point outside G at least one of the error probabilities for the two codes is bounded away from zero by a bound independent of the block length. Finally, these results may be partially generalized to channels with certain types of memory. If there exists an internal state of the channel such that it is possible to return to this state in a bounded number of steps, then there exists again a capacity region G with similar properties.

1494

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

A TWO-DIMENSIONAL GROWTH PROCESS, by M. Eden. [1960] [17]p. incl. illus. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Also published in Proc. Fourth Berkeley Symposium on Mathematical Statistics and Probability, California U., Berkeley (June 20-July 30, 1960), Los Angeles, California U. Press, 1961, v. 4: 223-239. (AFOSR-2135)

This report examines certain of the properties of populations of cells, in particular, properties relating to the architecture of cell colonies. The problem treated mathematically here is: given a single cell or a homogeneous population of cells, how can such a cluster develop into a structure of lower order of symmetry or no symmetry at all, that is, into a structure of recognizable and characteristic shape, without involving special structural properties of the cells themselves? A Monte Carlo procedure was devised to help examine the growth process. It is concluded that the analytical tools available at this time are insufficient for determining the probable structure of a group of cells of a complicated morphology. However, it is shown that if the biological analogue is a colony of cells growing wherever there is a nutrient medium, the colony will have the largely circular morphology exhibited by the model.

1495

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

COMPONENTS OF ELECTRICAL RESPONSES RECORDED FROM THE COCHLEA, by N. Y.-S. Kiang and W. T. Peake. [1960] [11]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and National Institutes of Health) AD 241807 Unclassified

Also published in Ann. Otol. Rhinol. and Laryngol., v. 69: 448-458, June 1960.

Electrical responses from denervated cochleas are studied with particular emphasis on the separation of the component potentials. Cochlear responses to a click were recorded with a round window electrode. At low intensities the normal cochlear microphonic potential (CM) reverses completely when the polarity of the click is reversed, whereas the action potential (AP) shows little change. The amplitude of CM in the denervated cochlea is unaffected by the rate of stimulation as long as the responses do not overlap. In normal cochlea rate functions for noise bursts and clicks of comparable intensities and duration are almost identical. The amplitude of AP decreases rapidly with stimulus rate for rates above 10/sec in the denervated specimen.

1496

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CORRELATION DETECTION OF SIGNALS PERTURBED BY A RANDOM CHANNEL, by T. Kailath. [1960] [6]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in I.R.E. Trans. on Information Theory, v. IT-6: 361-366, June 1960.

It is shown that the concept of correlation detection of deterministic signals in additive Gaussian noise can be extended in a natural manner to the detection of signals that are transmitted through a "Gaussian" random channel besides being corrupted by additive Gaussian noise. Such situations are typical in communication over

scatter-multipath channels (with or without a specular component). In the deterministic case, the receiver essentially crosscorrelates the received signal with the signal before the additive noise was introduced. When a random channel is present, however, this latter signal, i.e., the output of the random channel, is not known at the receiver. When the statistics of the channel and the noise are known, however, the receiver can make an estimate of it from the received signal on the hypothesis that a particular signal was transmitted. The optimum receiver then crosscorrelates this estimate with the received signal. (Contractor's abstract)

1497

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MEASUREMENTS OF FLUCTUATIONS IN RADIATION FROM A SOURCE IN THERMAL EQUILIBRIUM, by M. Harwit. June 1960, 101p. incl. illus. tables, refs. (Technical rept. no. 364) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108, and Office of Naval Research under Nonr-184140) AD 246390 Unclassified

The Bose-Einstein classical or beat frequency fluctuation in a stream of photons from a source in thermodynamic equilibrium is measured, and the Einstein-Fowler equation of statistical thermodynamic is verified. By quantum statistical means, the fluctuation in the stream of radiation incident on a detector from a source at temperature, T, is determined. The amount of cross-correlation expected for the output current of two detectors illuminated by this source is derived. The theory of the intensity interferometer, based on an electromagnetic formulation is reproduced, and the results are then compared to the quantum statistical results in the region of common applicability. The two theories are found to concur. In order to make the proposed measurements, a source in true thermal equilibrium is necessary, i.e., at 3500°K or less. Previously described intensity interferometers are excessively slow at these low temperatures and source intensities. The infrared spectral region is inherently optimum for speed in intensity interferometry, but a microwave maser system may be competitive with the best available infrared detectors. To the author's knowledge the system constructed to detect the sought fluctuations is the first infrared system using correlation techniques to detect signals far below the detector and the photon shot noise level. It uses cooled lead sulfide detectors and is capable of detecting signals with signal-to-noise ratios of 3% in about 20 min integration times. The results of the photon fluctuation experiments are reported. The measured correlation value agrees with the value predicted by the Einstein-Fowler equation, within the experimental error. An indication of the reliability of the entire set of measurements is the final signal-to-noise ratio of all measurements taken together. This is 3.9. (Contractor's abstract)

1498

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NEGATIVE L AND C IN SOLID-STATE MASERS, by R. L. Kyhl. [1960] [1]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 241808 Unclassified

Also published in Proc. Inst. Radio Engineers, v. 48: 1157, June 1960.

When a material exhibiting quantum-mechanical resonance absorption is caused to be emissive by producing an inverted population distribution, the impedance behavior of the material changes in two ways: (1) the resistive component becomes negative to provide gain; and (2) the dependence of the reactive component on frequency reverses sign. The second property can be used to obtain gain and bandwidth performance that exceeds the limitations imposed by conventional network analysis. For amplifier design calculations, it is convenient to represent this fact by an equivalent circuit. An example is given. The presence of the negative L and C terms does not materially change the performance of a typical traveling-wave maser because the circuit is too broadband to introduce sufficient compensating reactance.

1499

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DESIGN PROBLEMS IN PULSE TRANSMISSION, by D. W. Tufts. July 28, 1960, 48p. incl. refs. (Technical rept. no. 368) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 259772 Unclassified

Criteria for determining optimum pulse shapes for use in a synchronous pulse transmission link are proposed and compared. Formulas for the optimum pulses are presented, and calculations are carried through in examples. In a secondary problem, we present methods for calculating optimum interpolatory pulses for use in reconstructing a random waveform from uniformly spaced samples. The case of a finite number of samples and the case of an infinite number of samples are discussed. A mean-square criterion is used to judge the approximation. The results provide a generalization of the sampling principle. (Contractor's abstract)

1500

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

COUPLING OF MODES IN UNIFORM COMPOSITE WAVEGUIDES, by L. Bahiana and L. D. Smullin. [1960]

[5]p. incl. illus. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108])
AD 248720 Unclassified

Also published in I.R.E. Trans. on Microwave Theory and Tech., v. MIT-8: 454-458, July 1960.

The principle of coupling of modes is used to compute the phase constant in a uniform waveguide filled with two different dielectric materials. The natural modes of two hypothetical waveguides filled with the different dielectrics are computed. The propagation of the combined system is computed by considering the coupling between the approximate theory and an exact theory. (Contractor's abstract)

1501

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SEQUENTIAL ENCODING AND DECODING FOR THE DISCRETE MEMORYLESS CHANNEL, by B. Reiffen. Aug. 12, 1960, 98p. incl. diagrs. refs. (Technical rept. no. 374; Lincoln Lab. technical rept. no. 231) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

A scheme is described which sequentially encodes the output of a discrete letter source into the input symbols of a discrete memoryless channel, with adjacent channel symbols mutually constrained over a length, n. The encoder permits desired channel input symbol probabilities to be approximated closely. Decoding at the receiver is accomplished with delay n by means of sequential tests on potential transmitted sequences with reject criteria set so that incorrect sequences are likely to be rejected at short lengths and the correct sequence is likely to be accepted. Averaged over a suitably defined ensemble of encoders, the decoding scheme has an average probability of error, with an upper limit whose logarithm approaches -nE(R) for large n. E(R) is dependent only on the data rate, R. For a channel symmetric at its output with equally likely inputs, the exponent E(R) is optimum for rates greater than a rate called R_{crit}. For such symmetric channels, a computation cutoff rate, R_{cutoff} is defined. For $R < R_{cutoff}$, the average number of decoding computations per symbol does not grow exponentially with n; it is upper bounded by a quantity proportional to n raised to the power $2[1+R/R_{cutoff}]$. A procedure for reducing an arbitrary discrete memoryless channel to a symmetric channel is given. (Contractor's abstract)

1502

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ELASTIC CONSTANTS OF CADMIUM FROM 4.2°K TO 300°K, by C. W. Garland and J. Silverman. [1960] [5]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Phys. Rev., v. 119: 1218-1222, Aug. 15, 1960.

The adiabatic elastic constants of cadmium crystals have been measured by an ultrasonic pulse technique. The values extrapolated to 0° are: $c_{11} = 13.08$, $c_{33} = 5.737$, $c_{44} = 2.449$, $c_{12} = 4.048$, $c_{13} = 4.145$ in units of 10^{11} dynes/cm^2. A Debye characteristic temperature, θ_0, of 213° ± 1°K has been calculated from these 0°K elastic constants. The temperature dependence of the linear compressibilities, $K_{\parallel}$ and $K_{\perp}$, has also been calculated.

1503

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

LINEAR CANCELLATION TECHNIQUE FOR SUPPRESSING IMPULSE NOISE, by E. J. Baghdady. [1960] [9]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 251443 Unclassified

Presented at Western Electronic Show and Convention, Los Angeles, Calif., Aug. 23-26, 1960.

Also published in I.R.E. Wescon Convention Record, Pt. 7: 27-35, 1960.

The examples presented show that it is possible to achieve substantial reductions in the relative strength of impulsive disturbances by means of simple linear-cancellation circuits. This technique can be combined with a preclipping operation of appropriately chosen threshold to effect almost complete elimination of the harmful effects of impulse noise, although some forms of the linear-cancellation technique will achieve such a result without the use of preclipping. The subtraction that results in these reductions is effective against a moderate number of impulses whose effects overlap completely or partially; it is not effective against very large numbers of randomly superimposed impulses (such as shot noise for example) because of the large number of residual overlapping disturbances caused by the input noise pulses. (Contractor's abstract)

1504

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE SPECIFIC HEAT OF SUPERCONDUCTORS NEAR THE CRITICAL TEMPERATURE, by J. F. Cochran and P. Cochran. [1960] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Proc. Seventh Internat'l. Conf. on Low Temperature Phys., Toronto U. (Canada) (Aug. 29-Sept. 3, 1960), Toronto U. Press, 1961, p. 397-399.

The specific heat of superconducting metals is studied with respect to the possibility of a λ-transition. The preliminary results obtained for tin and tantalum, in which the specific heat near T_c was measured with a precision of a few % with the use of temperature increments of 10^{-4}°K, are described graphically. These data can be summarized as follows: (1) there is no singular term in the specific heat of tin and tantalum as large as that predicted by Kvasnikov (see Soviet Phys., Doklady, v. 3: 318, 1959); (2) the transition interval was much broader in temperature than had been expected from the high purity of the specimens; and (3) in one run, the tin specimen was warmed through T_c in a field of 0.4 gauss with no apparent shift in the transition temperature, although according to the critical field data for tin, the transition should have been shifted 0.0025°K. Future experiments will be carried out with single crystalline specimens.

1505

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NONLINEAR LEAST-SQUARES FILTERING AND FREQUENCY MODULATION, by A. D. Hause. Aug. 25, 1960, 49p. incl. diagrs. refs. (Technical rept. no. 371) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 258225 Unclassified

Investigation concerns the use of optimum nonlinear filtering for the recovery of messages from modulated signals in the presence of additive Gaussian noise. S/N, defined in a manner especially suited to nonlinear filtering, is taken as the measure of performance. This definition also provides a useful connection with the mean-square-error criterion. Each filter has a linear section and a nonlinear, memoryless section. Attention is focused primarily on the latter. A simplified review of important properties of the orthogonal polynomials employed by Wiener for representation of the nonlinear filter section is included; special emphasis is placed on the properties of Hermite polynomials because this is a cornerstone in the derivation of succeeding results. The low S/N performance of communication systems is shown to be related in a simple way to the structure of the optimum filter polynomial. The use of this nonlinear filter theory confirms the notion that conventional FM practice produces somewhat less than optimum reception at low S/N. This study indicates that the type of FM that has potentially the best performance in this range is narrow-band FM with a phase-synchronized carrier. Also, the proper use of amplitude information in the noisy FM signal improves performance moderately. (Contractor's abstract)

1506

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NONLINEAR OPERATORS FOR SYSTEM ANALYSIS, by G. Zames. Aug. 25, 1960, 76p. incl. illus. tables, refs. (Technical rept. no. 370) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 270735 Unclassified

The method of functional iteration as a means for solving nonlinear feedback equations is applied to a variety of feedback problems. Equations are written in terms of an operator algebra extracted from functional analysis and solved by geometric iteration. This method leads to a means of bounding the output in terms of the system loop gain, and to a procedure for synthesizing systems out of iterative physical structures. The theory is applied to the construction of an explicit model for the nonlinear distortion of a feedback amplifier, and to the proof of a theorem that states that a bandlimited signal having the width of its spectrum expanded by an invertible, nonlinear, no-memory filter can be recovered from only that part of the filtered signal which lies within the original passband; a filter for recovering the original signal is derived. (Contractor's abstract)

1507

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CODING FOR TWO-WAY CHANNELS, by J. M. Wozencraft and M. Horstein. [1960] [15]p. incl. diagrs. tables, refs. (Technical rept. no. 383) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 263005 Unclassified

Also published in Information Theory; Fourth London Symposium, Royal Institution, London (Gt. Brit.) (Aug. 29-Sept. 2, 1960), London, Butterworths, 1961, p. 11-25.

When time-variant noisy 2-way channels are protected by coding, they may be used to provide essentially noiseless, feedback, with delay. Service messages can be automatically exchanged between terminals, and

transmission altered in such a way that the average communication rate is increased, given fixed receiver computers. The system is somewhat similar to human communication, in that typical errors are corrected while grievous ones initiate a request for retransmission. One-way experimental data are presented to complement the approximate theoretical analysis. (Contractor's abstract)

1508

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

OPTIMUM RECEIVERS FOR RANDOMLY VARYING CHANNELS, by T. Kailath. [1960] [14]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Information Theory; Fourth London Symposium, Royal Institution, London (Gt. Brit.) (Aug. 29-Sept. 2, 1960), London, Butterworths, 1961, p. 109-122.

The problem is studied by means of a finite set of known signals of limited duration transmitted through a random linear time-variant channel, resulting in a wave form that is further corrupted by additive noise before being available as a waveform to the receiver. The optimum receiver in the sense of Woodward (Probability and Information Theory with Applications to Radar, London, Pergamon Press, 1953) computes the set of a posteriori probabilities. Some functional forms for such receivers are discussed. An attempt to obtain a physical understanding of their operation is also carried out. A model for the channel and the signals is described for the analysis. It is concluded that (1) the study applies, with appropriate change, to problems in diversity reception, optics and radar- and radio-astronomy; (2) the use of the assumption of gaussian statistics has enabled the study of the problem without having to make any approximation; and (3) it is particularly important to try to glean a physical interpretation for the action of the receiver.

1509

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SEQUENTIAL OBSERVATIONS BY HUMAN OBSERVERS OF SIGNALS IN NOISE, by J. A. Swets and D. M. Green. [1960] [19]p. incl. diagrs. tables. (Technical rept. no. AFCCDD TR60-21) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Information Theory; Fourth London Symposium, Royal Institution, London (Gt. Brit.) (Aug. 29-Sept. 2, 1960), London, Butterworths, 1961, p. 177-195.

The results of a preliminary investigation are reported of trading relationship between time and error in a very simple perceptual task, specifically, in a signal detection task. The observer must decide whether or not a signal exists in a background of noise. He is allowed to make as many observations as he chooses before making the decision. The theory of sequential analysis as a model for the observer's behavior in this task leads to the prediction that, for a given signal strength, the error rate and average number of observations preceding a terminal decision will vary inversely. Three experiments are carried out. The results are discussed with respect to (1) the determination of whether the error rates and mean number of observations vary appropriately as the changed pay-off rates; (2) the comparison of the efficiency of sequential tests and tests of fixed length; and (3) the determination of whether or not the observers combined the information in successive observations. It is concluded that (1) and (2) do follow as expected thus indicating that human observers are capable if integrating the information in successive observations.

1510

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE CHARACTERIZATION OF CURSIVE WRITING, by M. Eden and M. Halle. [1960] [13]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and National Science Foundation) Unclassified

Published in Information Theory, Fourth London Symposium, Royal Institution, London (Gt. Brit.) (Aug. 29-Sept. 2, 1960), London, Butterworths, 1961, p. 287-299.

A scientific account of cursive writing as practiced in the United States is given. The subject is chosen not only because writing is an intrinsically interesting form of human communicative behavior, but also because it is hoped that what is learned about writing and about reading of handwritten texts will throw new light on other forms of communicative behavior as well, in particular, on the acoustical analogue of script, speech,

1511

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SEQUENTIAL TRANSMISSION OF DIGITAL INFORMATION WITH FEEDBACK, by M. Horstein. Sept. 8, 1960, 64p. incl. diagrs. refs. (Technical rept. no. 375) (Sponsored jointly by Air Force Office of Scientific Research,

Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

This report is concerned with the asymptotic error-correcting capability of several types of sequential transmission and the examination of a particular sequential transmission scheme. Bounds on the error exponent are derived for several types of sequential transmission. It is shown that the error exponent of a sequential sphere-packed code is greater, at all rates less than capacity, than the largest exponent obtainable with a fixed-constraint-length block code. It is also shown, however, that asymptotically better error correction is possible with an information-feedback block-transmission system. Within the realm of information feedback, even larger error exponents can be obtained with continuous systems. (Contractor's abstract, modified)

1512

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A SIMPLIFIED METHOD FOR THE COMPUTATION OF ELECTRICAL PROPERTIES OF A CLOSED-SPACE THERMIONIC CONVERTER, by W. B. Nottingham. Sept. 9, 1960 [12]p. incl. diagrs. tables. (Bound with its Technical rept. no. 373; AD 246120) [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108] AD 246120
Unclassified

Also published in Report on the Twentieth annual Conf. on Physical Electronics, Massachusetts Inst. of Tech., Cambridge, Mar. 24-26, 1960, p. 58-69.

The closer the spacing of a high-vacuum thermionic converter the less its performance is governed by space charge and the more dependence must be placed on the producer to develop superior electron emitters. Whereas the theory applicable to the converter with an emitter of unlimited emission capability is less difficult, it is nevertheless possible to work out in a relatively simple manner all the equations that are applicable to the diode of limited emission capability. These methods are demonstrated and the results of the calculations are compared to those of Ritter, which are dependent on the application of a digital computer programmed to this type of problem and are based on rigorously derived space-charge equations. (Contractor's abstract)

1513

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

PROPERTIES OF A NEURON WITH MANY INPUTS, by M. Blum. [1960] [28]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and National Institutes of Health)
Unclassified

Published in Bionics Symposium, Dayton, Ohio (Sept. 13-15, 1960), Wright-Patterson Air Force Base, Wright Air Development Div., 1960, p. 55-82.

Also published in Principles of Self-Organization; Trans. of Illinois U. Symposium on Self-Organization, Robert Allerton Park (June 8-9, 1961), New York, Pergamon Press, 1962, p. 95-119.

This paper is a mathematical investigation of many-input neurons in nets with outputs more reliable than the outputs of individual neurons. The properties of a formal neuron as a computer component are pointed out. The input configurations are described using Venn diagrams. Algorithms are given for the construction of neurons from Venn diagrams and the problem of constructing neurons which are cheapest, in the sense that they receive a minimum number of fibers from the input is investigated.

1514

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

RELIABLE COMPUTATION WITH UNRELIABLE CIRCUITRY, by L. A. M. Verbeek. [1960] [9]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], National Institutes of Health, and Teagle Foundation, Inc.)
Unclassified

Published in Bionics Symposium, Dayton, Ohio (Sept. 13-15, 1960), Wright-Patterson Air Force Base, Wright Air Development Div., 1960, p. 83-91.

An outline of the structure of redundant networks composed from unreliable formal neurons resulting in reliable logical computation is given. The four sites of possible erroneous activity in the malfunction of formal neurons are pointed out. These are the failure to transfer the state of the input line to the formal neuron, the failure of the output line to be in the state prescribed by the activity of the formal neuron, fluctuations in the strength of the signals received from the input line, and the fluctuation of the threshold about the formal neuron's nominal value. The effects of threshold fluctuations and axonal error can be taken together by assigning an error probability α to each formal neuron. A discussion is also given on the malfunctions of neuronal networks.

1515

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

TOWARD A PROPER LOGIC FOR PARALLEL

COMPUTATION IN THE PRESENCE OF NOISE, by J. D. Cowan. [1960] [60]p. incl. diagrs. tables, refs. (In cooperation with Northeastern U., Boston, Mass.) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]; Air Force Cambridge Research Center under AF 19(604)3053, and International Computers and Tabulators, Ltd.) Unclassified

Published in Bionics Symposium, Dayton, Ohio (Sept. 13-15, 1960), Wright-Patterson Air Force Base, Wright Air Development Div., 1960, p. 93-152.

Assuming the existence of error-free encoders and decoders and performing only coordinate encoding, various many-valued logical schemes were investigated, none of which realized a nonzero computation rate for arbitrarily reliable computation. Any considerations of source statistics were neglected and only structures formed from parallel nets of identical neurons were considered. Slightly more complex nets in which each neuron computed a different function were also discussed. Finally, parallel nets of M-state components were analyzed and it was noted that nothing was gained by using the (M-2) intermediate states between 1 and M. (Contractor's abstract, modified)

1516

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

AN APPROACH TO THE QUANTITATIVE ANALYSIS OF ELECTROPHYSIOLOGICAL DATA FROM SINGLE NEURONS, by G. L. Gerstein and Y.-S. Kiang. [1960] [14]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and National Institute of Neurological Diseases and Blindness) AD 247532 Unclassified

Also published in Biophys. Jour., v. 1: 15-28, Sept. 1960.

The application of a digital computer to the processing of data from single neurons is described. Examples from experimental data are presented to demonstrate the usefulness of certain types of computations. These methods are placed in a descriptive mathematical framework. Other easily attainable compu 'ons are suggested. (Contractor's abstract)

1517

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SIMPLE TRANSISTOR-OPERATED OVEN-TEMPERATURE REGULATOR, by E. R. Pike and J. F. Cochran. [1960] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Rev. Scient. Instr., v. 31: 1005-1007, Sept. 1960.

The design and operation of a particularly simple circuit capable of holding the temperature of a test oven constant with ± 1°C over long periods are described. The transistors of the circuit are operated without the use of dc bias elements, so that their operating points vary with the instantaneous value of the supply voltage. For high temperature applications, the resistance element is constructed of a noninductively wound coil of 0.001- or 0.002-in. diam W-wire. Mo or Pt wire can also be used. For the best operation, it is necessary to connect the sensing element to the bridge by means of wires with a low temperature coefficient of resistance; alternatively, the wires may be thermally lagged. The sensitivity of the circuit can be improved by a factor of the order of 50 by the addition of a transistor amplifier between the bridge and the base of the first transistor. This amplifier circuit is described graphically.

1518

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SOUND SOURCE NEAR A VELOCITY DISCONTINUITY, by P. Gottlieb. [1960] [6]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 248126 Unclassified

Published in Jour. Acoust. Soc. Amer., v. 32: 1117-1122, Sept. 1960.

The far-field solution for a line and a point source near a tangential velocity discontinuity has been calculated by summing (integrating) the plane waves that make up the source. The exact field integrals were evaluated approximately by the stationary-phase method, and this approximation gives the far field. It was found that the sound was strongly peaked in some directions, and considerably reduced in others. This angular dependence is shown graphically for certain cases. The physical significance of these results is discussed for both subsonic and supersonic motions, and the relationship to the jet-noise problem is suggested. (Contractor's abstract)

1519

[Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.]

ADAPTIVE MATCHED FILTERS, by T. Kailath. [1960] [32]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Mathematical Optimization Techniques; a

Symposium, Santa Monica, Calif. (Oct. 18-20, 1960), Berkeley and Los Angeles, California U. Press, 1963, p. 109-140.

Adaptive concepts are applied to a particular reception problem of communication systems: that of deciding—from observation of a received waveform and complete knowledge of the statistical characteristics of a particular channel—which one of a finite set of possible transmitted waveforms (that are also known to the receiver) has actually been sent over the channel. For simplicity, the waveforms are considered to be of a sampled-data type and the channel to consist of a time-varying, linear, sampled-data filter. The channel filter has been represented as a tapped delay line with tap outputs summed through time-varying gain controls. From this model it is shown that if the instantaneous time-varying filter behavior is at all times exactly known to the receiver, then on the basis of detection theory, the optimum receiver operation is to crosscorrelate the received data and the various possible waveforms that could exist at the channel-filter output just ahead of the noise. One way of performing the crosscorrelation would be to pass the received signal into a set of matched filters (time-invariant linear filters). Lacking any direct knowledge, however, of the instantaneous channel-filter behavior, the possible waveforms that could exist just ahead of the noise are estimated, and the received data crosscorrelated against these estimates. Thus, the notion of an estimator correlator has been introduced, or equivalently, an adaptive matched filter that is governed by a prenoise waveform estimate.

1520

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PERCEPTION OF SPEECH-LIKE SOUNDS CHARACTERIZED BY A RAPIDLY CHANGING RESONANT FREQUENCY (Abstract), by P. T. Brady. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]; and National Science Foundation) Unclassified

Presented at Sixtieth meeting of the Acoust. Soc. Amer., San Francisco, Calif., Oct. 20-22, 1960.

Published in Jour. Acoust. Soc. Amer., v. 32: 1501, Nov. 1960.

A series of experiments concerned with the perception of sounds characterized by a moving resonance, i.e., one-formant sounds, has been performed. The stimuli are generated by exciting a tuned circuit of bandwidth 100 cps with a short train of pulses. The resonant frequency is varied linearly between 2 limits 500 cycles apart; increasing and decreasing frequency changes are investigated for terminal-frequency pairs 1000-1500 and 1500-2000 cps. By operation of a manual switch the pulse train is caused to excite a fixed resonant circuit, the frequency of which can be adjusted by a potentiometer. The subject's task is to adjust the potentiometer until the signal produced by the fixed resonant circuit is most like that produced by the time-varying circuit. Results indicate a strong tendency for subjects to adjust the frequency of the fixed resonant circuit to the final frequency of the time-varying circuit. Judgments can be forced toward the starting frequency of the transition if an initial steady-state portion precedes the transition.

1521

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

EFFECTS OF A BACKGROUND STANDARD ON DETECTION OF A NOISE SIGNAL (Abstract), by D. M. Green. [1960] [1]p. (Sponsored jointly by Air Force Cambridge Research Center; and Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at Sixtieth meeting of the Acoust. Soc. Amer., San Francisco, Calif., Oct. 20-22, 1960.

Published in Jour. Acoust. Soc. Amer., v. 32: 1505, Nov. 1960.

On each trial the observer hears 2 successive noise bursts: one I, the I + ΔI. The observer's task is to select the interval containing the increment ΔI. The parameter of the experiment is the level of a continuous background noise B. The detectability, evaluated in terms of signal to noise ratio, is best when the background noise B is some 5 to 7 db greater than the level of I. The Weber fraction and the shape of the psychophysical function, using this special procedure, are also different from those obtained using standard procedures. It is suggested that at least part of this effect is related to temporal uncertainty about the observation interval.

1522

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

AUTOMATIC MEASUREMENTS OF THE FORMANTS OF VOWELS IN DIVERSE CONSONANTAL ENVIRONMENTS (Abstract), by A. S. House, K. N. Stevens, and H. Fujisaki. [1960] [1]p. (Sponsored jointly by Air Force Cambridge Research Center; and Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at Sixtieth meeting of the Acoust. Soc. Amer., San Francisco, Calif., Oct. 20-22, 1960.

Published in Jour. Acoust. Soc. Amer., v. 32: 1517, Nov. 1960.

The principle of analysis-by-synthesis, described in earlier papers, is applied to the measurement of the formant frequencies of the common vowels of American

English. The vowels measured constitute segments of bisyllabic nonsense utterances recorded by 3 adult male talkers. The set of materials is designed to provide samples of stressed vowels preceded and followed by a variety of consonants. The vowels in question occur in consonant-vowel-consonant syllables in which both consonants represent the same phoneme of American English. Frequencies of the first three formants are measured throughout the vowel for spectral samples separated by approximately 8 msec. Effects on formant frequencies attributable to temporal location of sample, consonant environment, and individual talkers are discussed. For central locations of the samples, the formant frequencies differ systematically from published data derived from more restricted consonantal environments. Phenomena relating to formant transitions and individual talker characteristics are discussed.

1523

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SPECTRUM MATCHING OF FRICATIVE CONSONANTS (Abstract), by J. M. Heinz. [1960] [1]p. (Sponsored jointly by Air Force Cambridge Research Center; and Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at Sixtieth meeting of the Acoust. Soc. Amer., San Francisco, Calif., Oct. 20-22, 1960.

Published in Jour. Acoust. Soc. Amer., v. 32: 1517, Nov. 1960.

The frequency spectra of the voiceless fricative consonants of American English have been studied using digital computer methods. The speech materials and computer program are described in papers on vowel formants and nasal consonants presented at this meeting. Spectra characterized by transfer functions having 2 or more pairs of conjugate poles and 1 or more pair of conjugate zeros, together with simple source spectra, are generated in the computer for comparison with speech spectra in the steady-state portions of the fricatives. Also shown are examples in which the formants of the adjacent vowels are traced continuously through the transitions and into the consonants. Data on the position of the poles and zeros required to obtain a good match are given. The results will be related to an acoustic theory of fricative production.

1524

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SPECTRUM MATCHING OF NASAL CONSONANTS (Abstract), by O. Fujimura. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]; and National Science Foundation) Unclassified

Presented at Sixtieth meeting of the Acoust. Soc. Amer., San Francisco, Calif., Oct. 20-22, 1960.

Published in Jour. Acoust. Soc. Amer., v. 32: 1517, Nov. 1960.

The important features of sound spectra of nasal consonants have been examined quantitatively with the assistance of a computer. The computer program (1) allows the experimenter to select the frequencies and bandwidths of poles and zeros of an arbitrary transfer function, (2) calculates the corresponding sound spectrum, (3) provides visual comparison between the calculated spectrum and any given stored speech spectrum, and (4) calculates measures of the goodness of fit of the 2 spectra. The speech samples were drawn from the materials described in a paper on vowel formants presented at this meeting. In order to match spectra of nasal consonants in the frequency range below 3000 cps, 1 or 2 pole-zero pairs attributable to the closed oral cavity must be used, together with 3 or 4 poles. The bandwidths of the poles in nasal consonants are always greater than the bandwidths found in non-nasal vowels. The locations of poles and zeros which give the best match for [m] may vary significantly with vowel environment and may change during the period of mouth closure. Theoretical considerations can explain and to some extent predict these pole-zero characteristics.

1525

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

AUTOMATIC EXTRACTION OF FUNDAMENTAL PERIOD OF SPEECH BY AUTO-CORRELATION ANALYSIS AND PEAK DETECTION (Abstract), by H. Fujisaki. [1960] [1]p. (Sponsored jointly by Air Force Cambridge Research Center; and Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at Sixtieth meeting of the Acoust. Soc. Amer., San Francisco, Calif., Oct. 20-22, 1960.

Published in Jour. Acoust. Soc. Amer., v. 32: 1518, Nov. 1960.

A digital computer has been used to simulate schemes for automatic extraction of the fundamental period of speech by analysis of the waveform in the time domain. The basic principle is to apply 1-bit quantization to the signal samples followed by a short-time auto-correlation analysis with an averaging interval as short as 1 period of a low-pitched male voice. The peaks of the auto-correlation function corresponding to the period are then detected. In the determination of each period, reference is made to the immediately preceding decision, and several logical operations are introduced to reject minor

peaks. Measures of accuracy and reliability for various types of utterances are presented and discussed.

1526

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

AVERAGING TECHNIQUES APPLIED TO EVOKED RESPONSES, by M. H. Goldstein, Jr. [1960] [5]p. incl. diagrs. refs. [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108] Unclassified

Published in Computer Techniques in EEG Analysis; Proc. of Conf., California U., Brain Research Inst., Los Angeles (Oct. 29-30, 1960), New York, Elsevier Publishing Co., 1961, p. 59-63.

Published in Electroencephalog. and Clin. Neurophysiol. Jour., Suppl. 20: 59-63, 1961.

The average of responses are obtained either by analog or digital means on averagers which compute in real time and can be used to evoke responses as they occur in experiments. When the waveforms of the sample responses contain events of stable latency these events appear in the average of responses with any amplitude fluctuation considerably reduced by the averaging process. If the recorded potentials include activity that is unrelated to stimulation, the averaging technique will augment time-locked events relative to this background activity. When the background activity is large, averaging permits detection of small evoked responses that would otherwise be undetectable.

1527

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

NEURON FIRING PATTERNS AND THE SLOW POTENTIALS, by G. L. Gerstein. [1960] [4]p. incl. diagrs. [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108] Unclassified

Published in Computer Techniques in EEG Analysis; Proc. of Conf., California U., Brain Research Inst., Los Angeles (Oct. 29-30, 1960), New York, Elsevier Publishing Co., 1961, p. 68-71.

Published in Electroencephalog. and Clin. Neurophysiol. Jour., Suppl. 20: 68-71.

Using acoustic clicks, neurons are observed in the primary auditory cortex of lightly anesthetized cats. The population of cells under examination is limited to those cells which either show spontaneous activity, or can be activated by click stimulation. When a stimulus is presented, the slow potential may be averaged with respect to the stimulus instant. The past stimulus time histogram of the action potentials may be computed with respect to the stimulus instant. If there is no control over the stimulus, it is possible to cross-correlate the train of action potentials with the slow potentials.

1528

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

A DETAILED EXAMINATION OF THE PRINCIPLES OF ION GAUGE CALIBRATION, by W. B. Nottingham and F. L. Torney, Jr. Oct. 25, 1960, 10p. incl. diagrs. (Technical rept. no. 379) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) Unclassified

Published in Trans. Seventh Nat'l. Symposium on Vacuum Tech., Cleveland, Ohio (Oct. 12-14, 1960) London, Pergamon Press, 1961, p. 117-122.

As ionization gages are adapted to a wider variety of applications including, in particular, space research, the calibration accuracy becomes more important. One of the best standards for calibration is the McLeod gage, the use of which must be better understood and better experimental methods applied for obtaining satisfactory results. These details are discussed. The theory of the ionization gage itself is often simplified to the point that a gage constant is often determined in terms of a single measurement as $K = (1/P)(I_+/I_-)$. Experiments described show that, in 3 typical gages of the Bayard-Alpert type, K is not a constant but depends on both p and I_-. The best calibration range in electron current is generally less than 5×10^{-6} A. Significant changes in K with pressure take place in the calibration range of 10^{-4} to 10^{-3} mm Hg. Explanations are offered for the results observed in nitrogen, argon, and helium. (Contractor's abstract)

1529

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CYCLOTRON EMISSION FROM PLASMAS WITH NON-MAXWELLIAN DISTRIBUTIONS, by G. Bekefi, J. L. Hirshfield, and S. C. Brown. [1960] [8]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 260108 Unclassified

Presented at meeting of the Amer. Phys. Soc., Gatlinburg, Tenn., Nov. 2-5, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 205, Mar. 20, 1961.

Published in Phys. Rev., v. 12: 1037-1042, May 15, 1961.

Results of calculations of the cyclotron emission from mildly relativistic plasmas with non-Maxwellian electron distribution functions are described. Two classes of distribution functions are considered: (a) those that decrease monotonically with increasing energy; (b) those with one or more maxima displaced from zero energy. For (a), calculations of the radiation temperature were made from a generalization of Kirchhoff's law for non-Maxwellian distributions, and the emission, over the frequency range in which the self-absorption is large, exceeds by less than a factor of 10 that for a Maxwellian distribution of the same average energy. For (b), negative absorption occurs because the stimulated emission exceeds the absorption and leads to large amplification of the cyclotron radiation, particularly near the peaks of the lower harmonics. As an example, a Maxwellian distribution displaced by a net electron drift velocity that is small compared with the random velocity is considered.

1530

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

MEASUREMENTS OF THE ELECTRON VELOCITY DISTRIBUTION IN A HIGHLY IONIZED HOLLOW CATHODE DISCHARGE (Abstract), by W. D. Getty and L. D. Smullin. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Gatlinburg, Tenn., Nov. 2-5, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 205, Mar. 20, 1961.

The discharge is made by injecting argon gas through a 4-mm o.d. tantalum tube into a vacuum. A magnetic induction of 300-600 gauss is used to collimate the discharge. The gas flow rate is 0.1-100 atm cc/min and the background pressure varies between $0.5 - 1.0 \times 10^{-3}$ mm Hg. A Langmuir probe, placed near the visible edge of the discharge, yields a typical density of 2×10^{13} electrons/cc and a temperature of 3 ev. Microwave reflection from the plasma was investigated by illuminating the column at 35 kmc from an open waveguide located 1 cm from the discharge axis. The discharge was varied to determine plasma resonance, which occurs in substantial agreement with the probe results. These measurements indicate an ionization of more than 10%. Approximately two-thirds of the input power is dissipated at the anode; thus about 10% of the electrons have a drift energy of 20-80 v.

1531

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

AVERAGE RESPONSES TO CLICKS IN MAN RECORDED BY SCALP ELECTRODES, by C. D. Geisler. Nov. 4, 1960, 158p. incl. illus. table, refs. (Technical rept. no. 380) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 264724 Unclassified

Electric potentials were recorded from scalp electrodes in response to different sensory stimuli and, in particular, to clicks. These electric responses are usually too small to be detected in the electroencephalogram. With the use of an average-response computer, those components of the responses that are time-locked to the delivery of sensory stimuli can be studied. The present study deals with the characterization of average responses to acoustic-click stimuli in man. These responses were compared with evoked responses in subhuman species, and tentatively identified as secondary responses. The effects of the biological structures that separate the brain from a recording site on the scalp were investigated. The conclusion was made that the average click responses obtained from the human scalp are probably secondary cortical responses. This conclusion is based, in part, on two series of experiments: one in which the effects of multisensory stimulation were investigated, and another in which the effects of sleep upon average responses to clicks were studied. (Contractor's abstract)

1532

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE REFLECTION OF RADIO WAVES FROM AN IRREGULAR IONOSPHERE, by M. L. V. Pitteway. Nov. 8, 1960, 26p. incl. diagrs. refs. (Technical rept. no. 382) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 264721 Unclassified

Investigations were made of the reflection of radio waves from an irregular ionosphere. Research was extended to take account of strong scattering. Solutions of the wave equation for a horizontally stratified ionosphere are used as a starting point, and the equations governing scattering for a simple two-dimensional model are written in a coupled form. A ray theory of scattering is examined from a wave theory viewpoint, applied to scattering by an irregular layer of free electrons. Limited results of numerical work are exhibited in curves. Physical interpretations are presented of the mathematics outlined and useful approximations are given to help future work. (Contractor's abstract)

1533

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

MEASUREMENT OF MOTIONALLY INDUCED VOLTAGE IN SOME MAGNETOHYDRODYNAMIC CHANNEL FLOWS (Abstract), by W. D. Jackson. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Johns Hopkins U., Baltimore, Md., Nov. 21-23, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 205, Mar. 20, 1961.

The effect of a magnetic field directed transversely to the flow direction of a channeled, electrically conducting fluid is to modify the velocity profile with respect to the corresponding hydrodynamic case. This effect can be measured in terms of the voltage developed between a pair of electrodes or contacts appropriately located on the inner surface of the channel walls. Experimental results obtained with mercury and sodium chloride flows in circular, square, and rectangular channels for both laminar and turbulent flow conditions will be presented and will be shown to give satisfactory agreement in cases where the velocity profile and induced voltage can be predicted.

1534

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

USE OF ELECTROCHEMILUMINESCENCE FOR VISUALIZING FIELDS OF FLOW (Abstract), by R. C. Gesteland, B. Howland and others. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Johns Hopkins U., Baltimore, Md., Nov. 21-23, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 211, Mar. 20, 1961.

A platinum hydrofoil is immersed in a flowing, alkaline solution containing luminol (5-amino-2,3-dihydrophthalazinedione) and H_2O_2. Anodic current replaces the usual chemical catalysis, generating a bright surface glow with intensity distribution controlled by mass transfer. This clearly displays the flow at the boundary layer without disturbing it. A methanolic solution also shows the flow behind the hydrofoil; the luminescence leaves the anode and extends downstream along the trail of fluid that has passed through the boundary layer for a distance determined by the acidity. The subsequent history of parcels of fluids passing by any part of the hydrofoil can thus be traced when the current is delivered in pulses. Fluid may be recirculated; operation with organic solvents of low kinematic viscosity is possible.

1535

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

HYPERFINE STRUCTURE IN THE $^3P_1$ LEVEL OF THE TWENTY-FOUR-HOUR ISOMER OF MERCURY-197, by H. R. Hirsch. Nov. 25, 1960 [11]p. incl. diagrs. tables, refs. (Technical rept. no. 372) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 268487 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 51: 1192-1202, Nov. 1961.

The hyperfine structure of Hg^{197*} was measured with greater accuracy than had been obtained in conventional spectroscopic work. The nuclear magnetic dipole and electric quadrupole interaction constants, A and B, were calculated: A = 2328.8 ± 1.7 mc/sec; B = -901 ± 13 mc/sec. The isotope shift is 2240 ± 130 mc/sec relative to Hg^{198}. An electronic g value of 1.4861 ± 0.00036 was found for the $^3P_1$ level. The data were gathered with the use of level-crossing, double-resonance, and magnetic scanning techniques. The relatively new level-crossing experiment was applied to Hg^{199} and Hg^{197}. The measurements reported are useful in two ways: they lead to values of the nuclear moments and estimates of the nuclear charge distribution, and they pave the way for more accurate experiments that will yield data on the distribution of the nuclear magnetization. (Contractor's abstract)

1536

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

HEAVY ABSORPTION OF SPECTRAL LINE (Abstract), by R. H. Kohler. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago U., Ill., Nov. 25-26, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 412, Nov. 25, 1960.

Light from a single spectral line passes through a gas that has a single absorption resonance. The ratio of the transmitted to the incident flux is called the average

transmission. Closed-form expressions for the average transmission have been derived for the following conditions: (1) The incident and absorbing lines are each of pure Doppler shape. (2) There is no scattering coherence between the different absorbing molecules of the gas. (3) The average transmission is small. (4) The incident and absorbing lines, in general, are centered at different wave numbers. Condition(5) may result from isotope structure or magnetic fields. For optical-scattering applications, conditions (1) and (4) are approximations.

1537

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

Hfs AND ISOTOPE SHIFT IN RADIO-THALLIUM 199 AND 200 (Abstract), by R. J. Hull and H. H. Stroke. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108])
Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago U., Ill., Nov. 25-26, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 412, Nov. 25, 1960.

The hyperfine structure and isotope shifts of the 3776A and 5350A lines of 2 radioactive isotopes of thallium, Tl^{199}(7.4 hr) and Tl^{200}(27 hr), have been measured spectroscopically. The isotopes were produced by alpha bombardment of gold in the MIT cyclotron and were excited in electrodeless discharge lamps. The dispersing element of the spectrograph was a 10-in. grating, used in a 40-ft mirror monochromator. Measurements of these 2 lines give $\Delta\nu\,(6s^2 6p\,^2P_{\frac{1}{2}}) = 693 \pm 7 \times 10^{-3}$ cm^{-1} and $\Delta\nu\,(6s^2 7s\,^2S_{\frac{1}{2}}) = 398 \pm 6 \times 10^{-3}$ cm^{-1} for Tl^{199}. The Tl^{200} patterns appeared as single lines, indicating that the hfs was less than 0.040 cm^{-1}. The resulting magnetic moments calculated by comparison with the stable thallium hfs and moments with the Bohr-Weisskopf effect neglected, are + 1.57 NM and $|\mu| < 0.15$ NM for Tl^{199} and Tl^{200}. The isotope shift relative to Tl^{205} in the ultraviolet line is - 0.164 ± 0.004 cm^{-1} for Tl^{199} and -0.148 ± 0.004 cm^{-1} for Tl^{200}. The isotope displacements in the green line are -0.177 ± 0.004 cm^{-1} and - 0.169 ± 0.004 cm^{-1} for Tl^{199} and Tl^{200}, respectively, relative to Tl^{205}.

1538

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CROSSOVER TRANSITIONS, by M. W. P. Strandberg. [1960] [5]p. incl. diagr. table. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108])
Unclassified

Published in Jour. Phys. and Chem. Solids, v. 16: 39-43, Nov. 1960.

Finite-rotation operators are used to simplify the calculation of second-order, crossover transitions for a spin 3/2 system with trigonal symmetry. The resonant frequency and transition probabilities for the + 3/2, - 1/2 crossover transition with negative D(or + 1/2, - 3/2 with positive D) are calculated. (Contractor's abstract)

1539

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

HYPERFINE STRUCTURE OF Hg^{197}. AN APPLICATION OF THE LEVEL-CROSSING TECHNIQUE, by H. R. Hirsch and C. V. Stager. [1960] [2]p. incl. diagr. table. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 249364
Unclassified

Published in Jour. Opt. Soc. Amer., v. 50: 1052-1053, Nov. 1960.

Measurements in the 6 $^3P_1$ state of Hg^{197} yield a hyperfine structure splitting of 23,083.4 ± 6.7 mc. Such accuracy is possible in a strictly optical experiment because the change in intensity of scattered light observed at a Zeeman-level crossing is unaffected by Doppler broadening. (Contractor's abstract)

1540

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

MEASUREMENT OF THERMAL FLUCTUATIONS IN RADIATION, by M. Harwit. [1960] [7]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108])
AD 250494 Unclassified

Published in Phys. Rev., v. 120: 1551-1556, Dec. 1, 1960.

The thermal fluctuations in radiation are described

by the Einstein-Fowler relation $\langle(\Delta E)^2\rangle = kT^2 (\partial \langle E \rangle / \partial T)$. Two terms contribute to this fluctuation, a photon shot noise term and an expression predicted by wave theory. In the present experiment the second term was measured. (Contractor's abstract)

1541

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

RECOMBINATION OF ELECTRONS AND DONORS IN n-TYPE GERMANIUM, by G. Ascarelli and S. C. Brown. [1960] [12]p. incl. diagrs tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 250495 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 30-May 2, 1959.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 4: 227, Apr. 30, 1959. (Title varies)

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 194, Mar. 21, 1960. (Title varies)

Also published in Phys. Rev., v. 120: 1615-1626, Dec. 1, 1960.

A study was made of the recombination of electrons and donors in n-type germanium at helium temperatures. The excess electron density is obtained by means of low-temperature breakdown. Experimental results indicate that the recombination probability varies approximately with the inverse of the square of the temperature. Recombination light was detected. The origin of the disagreement of the present measurements with those published by S. H. Koenig (Jour. Phys. Chem. Solids, v. 2: 268, 1957) is discussed, and evidence is given to explain the discrepancies between the two measurements. The magnitude of the recombination cross section appears to depend on the binding energy of the electrons to the donor impurities, but large errors that are present in the determination of N_A are responsible for a large uncertainty in the absolute magnitude of the cross section. The cross sections vary from 10^{-12} to 10^{-11} cm^{-2}.

1542

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CODED, DIVERSIFIED, RAYLEIGH-FADED BINARY SYMMETRIC THRESHOLD CHANNELS, by R. R. Pfeiffer. Dec. 4, 1960, 32p. incl. illus. tables, refs. (Technical rept. no. 384) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under DA 36-039-sc-78108) AD 264722 Unclassified

The expressions for the probabilities associated with a Rayleigh-faded channel with null-zone detecting and diversity used are derived. Quantitative results of machine computation are presented for different orders of diversity. The bounds of decoding error of a coding scheme designed for a null-zone channel are evaluated. Quantitative results are presented for various word lengths and transmission rates. The channel statistics are combined with the coding-error bounds, and an examination of the effective power gains and increases in reliability is carried out. A few hypothetical tropospheric scatter links are set up to investigate the practicality of the combination. A qualitative determination of the situation for which it appears feasible to combine null-zone detecting, diversity, and coding is given. (Contractor's abstract)

1543

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SEARCH FOR A SMALL CHARGE CARRIED BY MOLECULES, by J. G. King. [1960] [4]p. incl. diagrs. table. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 252565 Unclassified

Published in Phys. Rev. Ltrs., v. 5: 562-565, Dec. 15, 1960.

Preliminary results of a Piccard-Kessler experiment are reported in which hydrogen molecules (and also helium atoms) exhibit a charge that is approx 40 times less than that required by the hypothesis of Lyttleton and Bondi. (Proc. Roy. Soc. (London, v. 252A: 313, 1959)

1544

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

FREQUENCY-POWER FORMULAS, by P. Penfield, Jr. Cambridge, Technology Press of M.I.T. and New York, Wiley and Sons. 1960 [160]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]; and Wright Air Development Division under (AF 33(616)3984)) Unclassified

Four types of power-frequency formulas are analyzed. Special emphasis is placed on the Manley-Rowe formulas which state that if the excitation of a non-linear capacitor is such that the current and voltage have frequency components of the form $m\omega_1 + n\omega_0$, where m

n are integers then,

$$\sum_{m=-\infty}^{\infty} \sum_{n=1}^{\infty} \frac{{}^{n}P_{mn}}{m\omega_1 + n\omega_0} = 0 \text{ and } \sum_{m=1}^{\infty} \sum_{n=-\infty}^{\infty} \frac{{}^{m}P_{mn}}{m\omega_1 + n\omega_0} = 0$$

where P_{mn} is the power input at frequency $m\omega_1 + n\omega_0$. Formulas relating reactive power at various frequencies in a nonlinear resistor are studied in addition to those which relate real power at various frequencies in nonlinear resistors. Finally, formulas which relate reactive power in nonlinear reactances are derived and discussed.

1545

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ANTIFERROMAGNETIC RESONANCE IN MANGANOUS CHLORIDE, by D. H. Douglass, Jr. and M. W. P. Strandberg. [1960] [17]p. incl. diagrs. refs. (Technical rept. no. 362) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Physica, v. 27: 1-17, Jan. 1961.

The magnetic resonance of antiferromagnetic manganous chloride at 9.0 kmc and 35.0 kmc as a function of temperature and orientation was investigated. Demagnetization effects were found to be important. A value of 13.000 gauss was found for $(2H_E H_A)^{\frac{1}{2}}$ at T = 0, and therefore $H_A(0)$ has a value of 5000 gauss. The effect of line narrowing when the rf frequency was increased was observed at all temperatures in both the antiferromagnetic state and the paramagnetic state. In the paramagnetic state at high temperatures this is called the 10/3 effect. The temperature dependence of the paramagnetic linewidth was found to vary quantitatively as $e^{A/T}$. In the antiferromagnetic state, the expression by Townes seems adequate. (Contractor's abstract)

1546

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MICROWAVE MEASUREMENTS OF THE RADIATION TEMPERATURE OF PLASMAS, by G. Bekefi and S. C. Brown. [1960] [6]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and Atomic Energy Commission) AD 252066 Unclassified

Published in Jour. Appl. Phys., v. 32: 25-30, Jan. 1961.

Radiation-temperature measurements of positive columns of glow discharges in helium, neon, and hydrogen were compared with calculations and the Langmuir probe measurements of the electron temperature. The microwave-noise radiation was detected at a frequency of 3000 mc. The plasma studied was illuminated by a blackbody source of known variable temperature. The blackbody temperature was adjusted until the received noise power became independent of the presence of the unknown plasma. At this point, the temperature of the 2 radiators is the same, irrespective of the magnitude of the plasma absorptivity. (Contractor's abstract)

1547

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

STRONG COUPLING IN NUCLEAR SPECTRA. IV. EXACT ANALYSIS OF THREE-SPIN SPECTRA, by S. Castellano and J. S. Waugh. [1960] [15]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Jour. Chem. Phys., v. 34: 295-309, Jan. 1961.

A method is developed for calculating the chemical shifts and spin-spin coupling constants for a system of 3 spin-1/2 nuclei (ABC) directly from the nuclear resonance spectrum. Trial- and-error adjustment of these parameters is avoided entirely, and the values obtained are exactly consistent with the input information. The use of experimental intensities is kept separate from that of experimental frequencies, and the former may be omitted entirely when experimental values of sufficient accuracy are not available. It is shown that previously unknown ambiguities in the assignment of parameters sometimes arise, and that conventional iterative analyses may occasionally lead to the wrong answer. The proton resonance spectra of 4 compounds containing vinyl groups are discussed as illustrations of the method.

1548

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DETECTION OF DOUBLE RESONANCE BY FREQUENCY CHANGE: APPLICATION OF Hg^{201}, by R. H. Kohler. [1960] [8]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 253613 Unclassified

Published in Phys. Rev., v. 121: 1104-1111, Feb. 15, 1961.

A new type of double-resonance experiment that depends on wavelength effects rather than on polarization effects is discussed. Incident polarized light is replaced by incident light of wavelength coincidence with just 1

component of the structure to be measured. The analyzer is replaced by a cell of gas that absorbs just that same component that lets the others pass. Magnetic resonance from the excited component to 1 of the others is monitored by increases in the light transmitted through the absorbing gas. This experiment requires that the Doppler width be smaller than the structure. This method was first applied to measure the hyperfine structure of the $^3P_1$ state of Hg^{201}. The incident light and absorbing gas were both supplied by separated Hg^{198}, whose resonance line coincides naturally with 1 component of the Hg^{201} hyperfine structure. Measurement of Hg^{201} is discussed in detail. The following hfs intervals were found: $f(1/2 \leftrightarrow 3/2) = 7551.613 \pm 0.013$ mc/sec and $f(3/2 \leftrightarrow 5/2) = 13{,}986.557 \pm 0.008$ mc/sec. The magnetic dipole and electric dipole interaction constants, calculated without quadratic hfs corrections, are $a = 5454.569 \pm 0.003$ mc/sec, $b = 280.107 \pm 0.005$ mc/sec. Means for applying the method when there is no isotope coincidence are given. This new method is compared with the polarization technique and is found to give signal-to-noise ratios that are orders of magnitude higher.

1549

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

CYCLOTRON RADIATION FROM A HOT PLASMA, by J. L. Hirshfield, D. E. Baldwin, and S. C. Brown. [1960] [6]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and Atomic Energy Commission) Unclassified

Published in Phys. Fluids, v. 4: 198-203, Feb. 1961.

Calculations of the incoherent cyclotron radiation from a hot plasma, based upon the single-particle model of Trubnikov and Bazhanova are presented. It is shown that the emission at frequencies higher than the blackbody cutoff frequency is not negligible under certain conditions, especially since it is relatively unaffected by proposed reflectors. An approximate absorption coefficient, which is inferred from the calculations, is used to obtain the real part of the refractive index from the Kramers-Kronig transform for comparison with the results of Drummond and Rosenbluth.

1550

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

KIRCHHOFF'S RADIATION LAW FOR PLASMAS WITH NON-MAXWELLIAN DISTRIBUTIONS, by G. Bekefi, J. L. Hirshfield, and S. C. Brown. [1960] [4]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and Atomic Energy Commission) Unclassified

Published in Phys. Fluids, v. 4: 173-176, Feb. 1961.

Calculations are given for the radiation temperature in terms of the average electron energy, to be used for interpreting microwave radiation measurements from plasmas with non-Maxwellian distributions of electron velocities.

1551

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

STATISTICAL ANALYSIS OF RADIO STAR SCINTILLATION, by S. Gruber. [1960] [13]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108] Unclassified

Published in Jour. Atmos. and Terrest. Phys., v. 20: 59-71, Feb. 1961.

Radio star scintillation data are analyzed by statistical techniques to determine the autocorrelation functions of power density spectra of the fluctuations in amplitude and phase. Interpretation is given in terms of a drifting phase-changing screen as postulated by Booker, Ratcliffe and Shinn (Philos. Trans., v. 242: 579, 1950). The drift velocity of the irregularities in ionospheric electron density that lead to the scintillations, as well as the mean square amplitude and phase of the fluctuations, may be obtained from these records. (Contractor's abstract)

1552

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE NUCLEAR RESONANCE SPECTRA OF ALLYLLITHIUM AND VINYLLITHIUM, by C. S. Johnson, Jr., M. A. Weiner and others. [1960] [2]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], National Institutes of Health and National Science Foundation) AD 258160 Unclassified

Published in Jour. Amer. Chem. Soc., v. 83: 1306-1307, Mar. 20, 1961.

The spectrum of allyllithium shows the well-separated doublet and quintet typical of spectra of the AX_4 type, from which the parameters are dervied by a first order analysis. Over times of 0.1 sec or less intra- or intermolecular lithium exchange involving the

allyllithium molecule seems apparent. The spectrum of vinyllithium, which is of the ABC type, was analyzed by iterated solution of the high resolution Hamiltonian. This study does not indicate whether vinyllithium is present in covalent or ionic form in solution.

1553

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ANALYSIS OF SPECIFIC HEAT DATA FOR ZINC RESOLUTION OF THE CALORIMETRIC AND ELASTIC Θ_0 DISCREPANCY, by C. W. Garland and J. Silverman. [1960] [2]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Jour. Chem. Phys., v. 34: 781-782, Mar. 1961.

The low-temperature heat capacity of zinc (in the normal state) has been expressed by $C_v = \gamma T + \alpha T^3 + \beta T^5$ over the range from 0.15°K to about 8°K. The new parameters obtained are: $\gamma = 1.56 \times 10^{-4}$ cal/deg^2 mol, $\alpha = 1.39 \times 10^{-5}$ cal/deg^4 mol, and $\beta = 2.44 \times 10^{-7}$ cal/deg^6 mol. The calorimetric Debye temperature, Θ_0^C, is found to be 322°K which is in reasonable agreement with the elastic value, Θ_0^E, of 328°K. The apparent disagreement between Θ_0^C and Θ_0^E values cited in the literature arises from the difficulty in analyzing the calorimetric data for a very anisotropic metal.

1554

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THERMAL NOISE IN DISSIPATIVE MEDIA, by H. A. Haus. [1960] [8]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Jour. Appl. Phys., v. 32: 493-500, Mar. 1961.

To account for the spontaneous thermal fluctuations in a general dissipative medium, a current-source term may be introduced into Maxwell's equations. The dyadic correlation function of the source term is evaluated for a uniform medium at uniform temperature in which the driving field $\bar{E}$ and driven-current density J_d are related by differential equations in time and space variables. In those cases in which a simple tensor relation exists between the Fourier components of $\bar{E}$ and J_d at a particular frequency, the result is generalized to nonuniform media. A similar generalization is achieved only under some restrictive assumptions for media characterized by differential equations in the space variables. The results obtained may be applied to the computation of thermal noise radiated from a medium at nonuniform temperature, and can serve as an aid toward understanding of noise mechanisms. The source terms is also evaluated for a thin plasma from simple physical reasoning and is found to check with the result derived from the general theory.

1555

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

LIQUID-CONTACT SUBSTRATE HEAT SINK, by A. G. Baker. [1960] [2]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108] and Bureau of Ships) AD 258159 Unclassified

Also published in Rev. Scient. Instr., v. 32: 454-455, Apr. 1961.

A heat sink has been constructed which allows a flowing liquid to be in direct contact with the back of the substrate. The liquid and vacuum seal consists of a single 1.75-in., i.d. buna-N O-ring with a cross-sectional diam of 1/16 in. Copper tubes carry the liquid into the vacuum system and through the heat sink to maintain the desired substrate temperature. This technique provides for replacement of the substrate in approx 15 sec.

1556

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MOLECULAR BEAM ELECTRON BOMBARDMENT DETECTOR, by R. Weiss. [1960] [4]p. incl. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Rev. Scient. Instr., v. 32: 397-401, Apr. 1961.

A molecular beam electron bombardment detector that detects approx 1/40 of a neutral beam falling into an area of 3×10^{-2} sq-cm is described. Molecular beams of sulfur dioxide and argon have been detected with signal-to-noise ratios of 2000/1 and 500/1, respectively. An improved design is discussed. (Contractor's abstract)

1557

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE ROLE OF PHONONS IN PARAMAGNETIC RELAXATION, by B. W. Faughnan and M. W. P. Strandberg. [1960] [12]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) AD 258156 Unclassified

Published in Jour. Phys. and Chem. Solids, v. 19: 155-166, Apr. 1961.

The coupled spin-lattice-bath system is investigated under conditions of microwave power saturation and the conditions for the existence of a steady-state non-thermal equilibrium phonon distribution are determined. The spin-lattice-bath equations are solved numerically for a few special cases involving a non-equilibrium distribution of phonons. The results of an experiment designed to detect the presence of non-equilibrium phonons are reported. No indication of the presence of such phonons was found. The experiments were performed using Cr^{+3} impurities in MgO, Al_2O_3 and $K_3Co(CN)_6$ and at T = 4.2°K and 2°K. The sensitivity of the experiment was such that for ruby a phonon temperature rise of $\Delta T = 0.005T$ could have been observed. Finally, the validity of the theory, in view of the experimental results, is discussed. (Contractor's abstract)

1558

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

INCOHERENT MICROWAVE RADIATION FROM A PLASMA IN A MAGNETIC FIELD, by J. L. Hirshfield and S. C. Brown. [1960] [7]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]; and Atomic Energy Commission) AD 258056 Unclassified

Published in Phys. Rev., v. 122: 719-725, May 1, 1961.

The microwave emission from a plasma in a magnetic field is calculated theoretically using Kirchhoff's radiation law for cases when characteristic waves do not couple within the plasma. Experimental observations of radiation temperatures and cyclotron radiation line breadth and shape are cited to illustrate applications of the theory to experiment. (Contractor's abstract)

1559

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DYNAMICS OF IONIZED GASES, by T. N. Dupree. [1960] [7]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 289, Apr. 21, 1961.

Published in Phys. Fluids, v. 4: 696-702, June 1961.

Ionized gas dynamics is discussed in terms of 2 coupled equations for the 1- and 2-particle distribution functions The equations have been obtained previously by multiple integration of the Liouville equation and a formal expansion in the specific volume. The 2-particle equation is solved for a multicomponent plasma in terms of 2 operators which depend on the 1-particle functions. It is shown that these operators have a simple interpretation and lend an easy insight into the correlation mechanism. If one neglects the time dependence of the 1-particle functions which occur in the operators, then the operators can be obtained explicitly. This procedure is shown to be valid for plasmas with "smooth" velocity distributions and no large inhomogeneities. When velocity instabilities exist, the correlation function is subject to growing oscillation. The ultimate effect of this instability is not clear. (Contractor's abstract)

1560

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

EVOKED CORTICAL ACTIVITY FROM AUDITORY CORTEX IN ANESTHETIZED AND UNANESTHETIZED CATS, by N. Y.-S. Kiang, J. H. Neame, and L. F. Clark. [1960] [2]p. incl. diagrs. table. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108], and National Institute of Neurophysiological Diseases and Blindness) Unclassified

Published in Science, v. 133: 1927-1928, June 16, 1961.

The averaging of results was employed to study the evoked electric responses of the auditory cortex of unanesthetized cats. The results do not in any way invalidate existing studies on the electric correlates of conditioning. The data emphasize the fact that the behavior of ER (early surface positive deflection of the classical evoked response), as well as that of other components of the ERC (evoked response complex), can be studied as a function of stimulus parameters and organismic states, provided the ERC is adequately displayed.

1561

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

HIGH-RESOLUTION GRATING MONOCHROMATOR FOR SIMULTANEOUS OBSERVATIONS OF MORE THAN ONE WAVELENGTH, by H. H. Stroke and K. K. Y. Li. [1960] [3]p. incl. illus. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in Jour. Opt. Soc. Amer., v. 51: 678-680, June 1961.

Camera mirrors are added to a high-dispersion grating monochromator to extend its application to the simultaneous observation of 2 (or several) wavelengths. The introduction of the additional mirror is accomplished at no sacrifice of aperture size. Rotation of the camera mirrors adequately separates the various wavelengths on the photographic plate.

1562

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

IMPEDANCE TRANSFORMATION USING LOSSLESS NETWORKS, by J. D. Schoeffler. [1960] [7]p. incl. diagrs. table, refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Published in I.R.E. Trans. on Circuit Theory, v. CT-8: 131-137, June 1961.

Two impedances are said to be compatible if 1 of them can be realized as the input impedance to a 2-terminal-pair lossless network terminated in the other impedance. A uniqueness property of the Darlington realization procedure and the methods of cascade synthesis are used to determine a simple, concise set of necessary and sufficient conditions under which 2 given realizable impedances can be compatible. Applications are discussed. (Contractor's abstract)

1563

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

INFLUENCE OF COULOMB INTERACTIONS ON THE CYCLOTRON RADIATION OF ELECTRONS MOVING ON A SINGLE ORBIT, by R. Gajewski and J. L. Hirshfield. [1960] [4]p. (In cooperation with Case Inst. of Tech., Cleveland, Ohio) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108] and Atomic Energy Commission) Unclassified

Published in Phys. Fluids, v. 4: 736-739, June 1961.

The incoherent cyclotron radiation at the n^{th} harmonic of the cyclotron frequency from N electrons moving on a single orbit is reduced by at least a factor $\pi^2 n^2 N^{-\rho}$ as a result of the nearest-neighbor Coulomb interactions ($\rho \geq 1$), whenever the electron's random thermal energy is less than Coulomb energy. The conditions under which this theory is valid are compared with those prevailing in the Astron E layer. (Contractor's abstract)

1564

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

JOULE HEATED OVEN-TYPE EVAPORATOR, by A. G. Baker. [1960] [1]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108] and Bureau of Ships) Unclassified

Published in Rev. Scient. Instr., v. 32: 740, June 1961.

A molecular beam oven, approximating a point source evaporator has been designed. The oven consists of a tantalum tube about 1½ in. in length and flattened at both ends. A small hole approx 1/32 in. in diam is drilled near one end. The material to be evaporated is inserted in this hole in wire form and an alternating current of 50 to 250 amp is passed through the tube to produce the heat necessary to vaporize the evaporant.

1565

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

TURING MACHINES, FINITE AUTOMATA AND NEURAL NETS, by M. Arbib. [1960] [9]p. [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108] Unclassified

Published in Jour. Assoc. Comput. Mach., v. 8: 467-475, Oct. 1961.

The notions of Turing machine, finite automation, and neural net are compared. A new notation is introduced to replace net diagrams. Equivalence theorems are proved for nets with receptors, finite automata, effectors, and Turing machines and are discussed in relation to papers of Copi, Elgot and Wright; Rabin and Scott; and McCulloch and Pitts. It is shown that sets of positive integers accepted by finite automata are recursive. A strengthened form of a theorem of Kleene is proved. (Contractor's abstract, modified)

1566

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

OFF-RESPONSES FROM THE AUDITORY CORTEX OF UNANESTHETIZED CATS, by N. Y.-S. Kiang and T. T. Sandel. [1960] [14]p. incl. illus. refs. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]; and National Institutes of Health) AD 258925 Unclassified

Also published in Arch. Ital. Biol., v. 99: 121-134, 1961.

Auditory off-responses that are abolished by barbiturate anesthesia have been found in the cortex of unanesthetized cats. From the nature of the stimuli used to evoke these responses (bursts of noise), it is certain that they are not the result of click-like transients. It is suggested that these responses represent a release of inhibition because a synchronous burst of activity cannot be found at the periphery when noise is turned off. (Contractor's abstract)

1567

Massachusetts Mental Health Center, Boston.

THE FREQUENCY OF NATURALLY OCCURRING HYPNOTIC-LIKE EXPERIENCES IN THE NORMAL COLLEGE POPULATION, by R. E. Shor. [1960] [13]p. incl. diagrs. (AFOSR-64-0827) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)728, National Institute of Mental Health, and Society for the Investigation of Human Ecology) AD 438385 Unclassified

Also published in Internat'l. Jour. Clin. and Exp. Hypnosis, v. 8: 151-163, July 1960.

The investigation secured normative data on the frequency of naturally occurring hypnotic-like experiences in the normal college population. Two college classes with a combined N of 145 students were presented with a 44-item paper-and pencil questionnaire where they were asked if they ever had each experience. The overall results were that naturally occurring hypnotic-like experiences—as defined by the questionnaire—are fairly common, widely distributed, and consistent among the 2 groups, although there was a tendency for reported frequencies to be higher in 1 group than in the other. A number of lines of further investigation are indicated and some theoretical implications are cited. (Contractor's abstract)

1568

Massachusetts U. Dept. of Chemistry, Amherst.

CHEMISTRY OF HYDRAZINE DERIVATIVES, by L. A. Carpino. Final rept. July 15, 1956-Feb. 15, 1960, 2p. incl. diagrs. (AFOSR-TR-60-24) (AF 18(603)114) PB 149687 Unclassified

The work of this contract has been concerned with a study of the oxidative reactions of hydrazine derivatives. The guiding hypothesis has been that oxidation of monosubstituted hydrazines occurs through derivatives of diimide whereas oxidation of 1,1-disubstituted hydrazines occurs through azamine intermediates. A new method of converting certain 1,1-disubstituted hydrazines to hydrocarbons was discovered and the scope of the reaction delineated. New synthetic routes to a wide variety of hydrazines were developed. Examination of the Forster azotization reaction led to the necessity of synthesizing representatives of a new class of organic compounds, the O-acyl and O-arenesulfonylhydroxylamines. These unique hydroxylamine derivatives promise to be useful aminating agents. A study of the oxidation of N-aminodihydroisoindole derivatives has provided preliminary evidence on the question of the intermediacy of O-quinodimethanes in the formation of benzocyclobutenes and related compounds.

1569

Materials Research Corp., Yonkers, N. Y.

BASIC INVESTIGATION OF CERAMIC FIBRE-ALLOY COMPACTS, by M. M. Skrill, E. S. Machlin, and S. Weinig. Final rept. Feb. 1, 1959-Jan. 31, 1960. Mar. 8, 1960 [21]p. incl. diagrs. tables. (MRC rept. no. R152) (AFOSR-TR-60-36) (AF 49(638)572) Unclassified

Techniques of producing composite materials of nonmetallic fibers and metals and the results of testing such composites with the view of evaluating the factors that affect their strength are presented. It was found that aluminum coated E-glass fibers were reduced in strength upon being infiltered by molten aluminum to produce aluminum-fiber composites. The strength to longitudinally oriented fiber composites obeys the equation $S_c = V_f \times S_f + (1-V_f)\, S_m$ where V_f is the volume fraction of the fibers, S_f is the strength of the fibers, and S_m is the strength of the metal. Short fibers do not contribute strength beyond that expected for equivalent dispersed particle hardening. Vapor coating fibers with unreactive metals provides protection from attack during compact manufacture and the strength of barrier coated fibers in compacts equals the strength in the uncoated stage prior to treatment. The ductility of compacts in which the fibers are oriented at about 45° to the tensile axis is about 5% and the strength of such compacts is unexpectedly about the same as the longitudinally oriented fiber compacts. The yield strength (0.2%) is much higher than that for the unreinforced metal. (Contractor's abstract)

1570

[Maudsley Hospital, London (Gt. Brit.).]

NEUROLOGICAL SITE OF ACTION OF STILBOESTROL IN ELICITING SEXUAL BEHAVIOUR, by G. W. Harris, R. P. Michael, and P. P. Scott. [1957] [20]p. incl. illus. diagrs. tables, refs. [AF 61(514)953] Unclassified

Published in Ciba Foundation Symposium on the Neurological Basis of Behaviour, London (Gt. Brit.) (July 2-4, 1957, London, J. and A. Churchill Ltd., 1958, p. 236-254.

The results of this investigation show that the latent period of the response of various tissues of the spayed female cat to estrogen, administered subcutaneously, varies with the daily dose-level employed. At high dosages, the maximum effect of the estrogens on the central nervous system may develop in 3 days whereas full cornification of the vagina does not occur before 4 or 5 days. At low dosages, full vagina cornification occurs before the full development of sexual behavior, and may precede the occurrence of mating by periods of up to 2 wk. Implantation of small amounts of solid stilbestrol dibutyrate in the posterior hypothalamus of spayed cats, leads, in the majority of experiments, to the full development of sexual behavior, although the genital tract remains anestrous. Similar control implants, placed subcutaneously or in other sites in the central nervous system do not result in mating in spayed cats. There are strong grounds for believing that the sexual activity behavior consequent to the hypothalamic implant is due to the local action of the stilbestrol on some nervous mechanism.

1571

Maudsley Hospital, London (Gt. Brit.).

THE ACUTE EFFECTS OF INJECTION OF THYROTROPHIC HORMONE OR OF ELECTRICAL STIMULATION OF THE HYPOTHALAMUS ON THYROID ACTIVITY, by H. J. Campbell, R. George, and G. W. Harris. [1960] [20]p. incl. illus. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)953 and Maudsley Hospital Research Fund) Unclassified

Published in Jour. Physiol., v. 152: 527-544, July 1960.

A technique has been devised for observing acute changes in thyroid activity in anesthetized rabbits over periods of about 8 hr. About 90% of the radioactivity of injected I^{131} was found to be protein bound, so that changes in radioactivity in arterial and thyroid venous blood could be taken to reflect changes in thyroid function. Administration of exogenous TSH resulted in a marked increase in radioactivity in thyroid venous blood, commencing in 15-30 min and reaching peak values in about 2 hr. Adrenaline or noradrenaline injection did not elicit this response nor modify that of the TSH. Electrical stimulation of the hypothalamus in the region of the supraopticohypophysial tract evoked the same response as the TSH injection. It is concluded that an acute preparation may be satisfactorily used for investigating factors which influence thyroid function.

1572

Maudsley Hospital, London (Gt. Brit.).

AN ATTACHMENT OF PROTAMINES TO CEREBRAL TISSUES, STUDIED IN RELATION TO GANGLIOSIDES, SURAMIN AND TISSUE EXCITABILITY, by C. G. Thomson and H. McIlwain. [1960] [6]p. incl. diagr. tables, refs. (AFOSR-512) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)-404] and Medical Research Council) AD 262287 Unclassified

Also published in Biochem. Jour., v. 79: 342-347, May 1961.

Protamine added to media in which cerebral cortical tissue is incubated is taken up by the tissue, which loses its metabolic response to electrical pulses. Uptake is small in 10 min, but nearly maximal in 30 min. Uptake of protamine is diminished by concentrations of gangliosides which diminish the action of protamine on tissue excitability. Protamine already attached to the tissue is not, however, removed by subsequent incubation in ganglioside-containing solutions. Protamine diminishes the uptake of fluid that normally occurs on incubating cerebral tissues in vitro, both with and without application of electrical pulses. Gangliosides oppose protamine in this respect also. Suramin, which also diminishes the action of protamine, again prevents the binding of protamine by cerebral tissues but does not remove protamine already attached. Suramin added to incubating fluids itself becomes attached to cerebral tissues; the quantity bound is independent of previous exposure of the tissue to protamine, but is similar to that of the protamine whose action it opposes. (Contractor's abstract)

1573

Maudsley Hospital, London (Gt. Brit.).

ASSAY OF THYROTROPHIC HORMONE IN BLOOD, by D. J. El Kabir. [1960] [2]p. incl. illus. table. (AF 61-(052)454) Unclassified

Published in Nature, v. 194: 688-689, May 19, 1962.

A new method for the assay of thyrotrophic hormone is described that is sensitive enough to detect the amounts of hormone normally circulating in the blood and also overcomes certain shortcomings from the point of view of statistical validity. The modifications include (1) the use of in-bred guinea pigs from a source known to be suitable for assay, (2) pre-treatment of the assay with either propylthiouracil or tapazole, (3) adoption of a standard 2-point assay design for each assay with

analysis of variance and factorial analysis, and (4) the use of a smaller log-dose interval. The results obtained with these modifications are in close agreement with the expected results from theoretical considerations.

1574

[Max-Planck-Institut für Strömungsforschung, Göttingen (Germany)].

EXPERIMENTS RELATING TO THE INTERACTION OF SOUND AND TURBULENCE, by D. W. Schmidt. [Annual survey rept.] Dec. 1, 1958-Nov. 30, 1959, 19p. incl. illus. diagrs. (AFOSR-TN-60-347) (AF 61(514)-1143) AD 236341; PB 147110 Unclassified

Experimental results about the scattering of sound by a turbulent flow are given. The dependence of the scattering on the frequency of sound and on the direction of the scattering vortices was investigated. Equipment is described which facilitates the use of hot-wires for the measuring of turbulence. Design characteristics of an apparatus are given, by which hot-wire probes can be rewired precisely and quickly. (Contractor's abstract)

1575

Max-Planck-Institut für Psychiatrie, Munich (Germany).

ELECTRON MICROSCOPIC CHANGES IN BRAIN TISSUE OF SYRIAN HAMSTERS FOLLOWING ACUTE HYPOXIA, by H. Hager, W. Hirschberger, and W. Scholz. [1959] [9]p. incl. illus. refs. [AF 61(052)945] Unclassified

Presented at Thirtieth annual meeting of the Aero Medical Assoc., Los Angeles, Calif., Apr. 1959.

Published in Aerospace Med., v. 31: 379-387, May 1960.

Structural changes of a particular type, partly reversible in character are shown by electron microscope to be produced in hypoxidosis. The first example, seen even under low electron microscope magnification, shows severe changes in the perikaryon of the nerve cells. The most pronounced changes are in the mitochondria which become swollen and more spherical. Their internal membranes lose their parallel structure, become fragmentated, and finally disappear almost completely. The mitochondria matrix loosens and becomes invisible, and the mitochondrion itself is transformed into a one membrane bound vacuole. The granules of Palade become rarefied or form clumps. The membrane systems of the endoplasmic reticulum separate and the continuity is broken. The ultramicroscopical findings suggest the interpretation that severe acute hypoxia causes a rise of the intracellular osmotic pressure, due to an increasing concentration of osmotically active components.

1576

Méditerranéen de Recherches Thermodynamiques, Nice (France).

THE SPUTTERING OF MOLECULES OF A THIN LAYER BY A LOW DENSITY SUPERSONIC FLOW IN FREE MOLECULAR REGIME, by F. M. Devienne and G. M. Forestier. Dec. 1959 [27]p. incl. diagrs. tables. (AFOSR-TN-60-317) (AF 61(052)124) AD 236320 Unclassified

The study of the stability of cadmium and antimony thin layers was effected in a rarefied gas supersonic wind tunnel either in an air or an argon flow. Radioactive isotopes were used in this study. It was shown that at a same temperature, the cadmium and antimony thin layers are less stable in a gas flow at great speed, than in vacuum. (Contractor's abstract)

1577

Méditerranéen de Recherches Thermodynamiques, Nice (France).

RESEARCHES ON THE PHENOMENA OBSERVED WHEN A BODY IS MOVING IN AN IONIZED ATMOSPHERE BY THE METHOD OF THE REVOLVING ARM, by F. M. Devienne and A. Roustan. July 1960 [70]p. incl. illus. diagrs. tables. (AFOSR-TN-60-907) (AF 61(052)124) AD 242183; PB 150345 Unclassified

The phenomena produced on a body moving through an ionized atmosphere and the trajectory of that body are studied using the revolving arm method. Ionization was obtained with a high frequency field produced by an oscillator whose frequency may range between a few and a 100 mc. A pulse generator was used to study the equilibrium phenomena in rarefied gas. Langmuir probes were used to measure ionization. The variations of the ionic current received by a metallic surface as a function of the velocity were shown to be smaller than theory predicts, due to the repulsion of ions by surface impurities. Temperature increases in the ionized gas were measured by comparison with rises in non-ionized gas at the same pressure. Variations of ionic density produced near the trajectory of the body in motion are shown.

1578

Méditerranéen de Recherches Thermodynamiques, Nice (France).

PRODUCTION OF A MOLECULAR BEAM AT A VERY HIGH SPEED AND RELATIVELY GREAT DENSITY--REALIZATION OF A MOLECULAR GUN, by F. M. Devienne and J. Souquet. June 1960 [36]p. incl. illus. diagrs. (AFOSR-TN-60-908) (AF 61(052)296) AD 244407 Unclassified

Also published in Rarefied Gas Dynamics, Proc. Second Internat'l. Symposium. California U., Berkeley (Aug. 3-6, 1960), New York, Academic Press, 1961, p. 83-98. (Title varies)

The molecular beams are obtained by utilizing the process of charge or momentum exchange between an ion beam and a low speed molecular beam. The development of the molecular gun is described schematically. The principal operational problems are discussed with respect to obtaining the ionic beam; the separation of the ions from the molecules; the acceleration of the ions; the method of producing of the charge or momentum exchanges between the ions and molecules with a maximum rate and at the same time with a minimum dispersion; the separation of the high speed molecules from the other neutral or electrical particles; the detection of the high speed molecules and the measurement of their speed; and the obtaining of a very high vacuum on the outside of the ionic and molecular beams. Preliminary studies using Ar indicated a beam intensity of 3×10^{16} molecules/sq cm/sec and in the speed range of 20 km/sec. Higher intensities exceeding 10^{18} molecules/sq cm/sec and ranging between 10-30 km/sec are hoped to be achieved using N_2. This apparatus offers the possibility to study all the interaction phenomena between a body moving at cosmic speed in the free molecular flow regime.

1579

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

RECENT RESULTS IN THE CONTINUUM THEORY OF VISCOELASTIC FLUIDS, by B. D. Coleman and W. Noll. May 1960, 85p. incl. refs. (AFOSR-TN-60-606) (In cooperation with Carnegie Inst. of Tech., Pittsburgh, Pa.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)541 and National Science Foundation under NSF-G5250) AD 239077; PB 148527 Unclassified

Presented at Conf. on Thermodynamics and Mechanics of Polymer Systems, New York, May 27, 1960.

Also published in Ann. New York Acad. Sci., v. 89: 672-714, Jan. 16, 1961.

This article is concerned with phenomenological aspects of the mechanical behavior of viscoelastic fluids. A mathematical definition of a simple fluid is given in sufficiently general terms to include perfect fluids, Newtonian fluids and viscoelastic fluids as special cases. In the discussion of the behavior of a simple fluid in steady simple shearing flow, it turns out that for incompressible fluids several flow problems can be solved by direct appeal to the definition. Discussion is also afforded on the behavior of simple fluids in periodic motions. A general smoothness assumption is formulated making it possible to prove a theorem which seems to justify the intuitive notion that for most fluids the theory of the Newtonian fluid should be a first-order correction to the theory of perfect fluids in the limit of slow motions.

1580

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

AN APPROXIMATION THEOREM FOR FUNCTIONALS, WITH APPLICATIONS IN CONTINUUM MECHANISMS, by B. D. Coleman and W. Noll. July 1960, 33p. (AFOSR-TN-60-826) (In cooperation with Carnegie Inst. of Tech., Pittsburgh, Pa.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)541 and National Science Foundation under NSF-G5250) AD 240815; PB 149810 Unclassified

Also published in Arch. Rat. Mech. and Anal., v. 6: 355-370, 1960.

The functional relationship, $\underset{\sim}{\sigma} = \overset{\infty}{\underset{s=0}{F}}(g(s))$, states that the present value $\underset{\sim}{\sigma}$ of a physical quantity is determined by the values $g(s)$ of a second quantity at all times in the past. The value of the second quantity is $g(s)$ s time units age. The above is the physical motivation behind the mathematical considerations presented in the first part of this paper. Physical experience indicates that phenomena which could be expected to be described exactly by a normalized functional relationship often follow a simpler relation of the form $\underset{\sim}{\sigma} = 1\,(\overset{(1)}{g}),\ \overset{(1)}{g} = \frac{d}{ds}\, g(s)\big|_{s=0}$, where $\underset{\sim}{1}$ is a linear transformation. It is the purpose of this paper to prove an approximation theorem of this kind. This theorem is then applied to constitutive equations of continuum mechanisms. The main interest is in the logical status of the theory of Newtonian fluids within the framework of a recently proposed general theory of fluids with memory effects. It is concluded that the Newtonian theory is the complete first-order approximation to the theory of simple fluids for slow flows. It is also pointed out that several special flow problems for incompressible second-order fluids lead to third-order linear partial differential equations.

1581

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

ON THE FOUNDATION OF LINEAR VISCOELASTICITY, by B. D. Coleman and W. Noll. [1960] [46]p. incl. refs. (AFOSR-TN-60-1367) (In cooperation with Carnegie Inst. of Tech., Pittsburgh, Pa.) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)541] and National Science Foundation under NSF-G5250) AD 246689; PB 153292 Unclassified

Also published in Rev. Modern Phys., v. 33: 239-249, Apr. 1961.

The fundamental hypothesis of linear viscoelasticity is reexamined in the light of recent advances in nonlinear continuum mechanics. This article tries to make more precise some past observations about smoothness, and in so doing seeks to obtain a mathematical derivation of infinitesimal viscoelasticity from plausible macroscopic assumptions. In order to do this a topology is introduced into the space of functions characterizing the history of the deformation, i.e., a way of knowing when 2 histories are close to each other. This is accomplished by defining a norm which has 2 important properties: (1) it makes the space of histories a Hilbert space, and (2) it places greater emphasis on the deformation which occurred in the recent past than on those which occurred in the more distant past. The arguments presented show that finite linear viscoelasticity furnishes a complete first-approximation to the theory of simple materials in the limit in which the history of the deformation, taken relative to the present configuration, is small in norm. The second-order theory of viscoelasticity for incompressible simple fluids is also discussed.

1582

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

NORMAL STRESSES IN SECOND-ORDER VISCOELASTICITY, by B. D. Coleman and W. Noll. [1960] [14]p. (AFOSR-TN-60-1461) (In cooperation with Carnegie Inst. of Tech., Pittsburgh, Pa.) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)541 and National Science Foundation under NSF-G5250) AD 248596; PB 153749 Unclassified

Presented at Symposium on Mechanics of Continua, Mellon Inst., Pittsburgh, Pa., Oct. 31-Nov. 2, 1960.

Also published in Trans. Soc. Rheol., v. 5: 41-46, 1961.

An analysis is given which stipulates that the classical linear theory of viscoelasticity should perhaps be called infinitesimal viscoelasticity because it is a theory which can be applicable only to those physical situations in which the deformation, computed relative to a fixed configuration, has been infinitesimal at all times in the past. Simple materials are defined by the property that the stress is given by a functional of the history of the deformation gradient. A differentiability assumption is formulated in function space and this assumption is used to prove that infinitesimal viscoelasticity is valid for simple materials when the deformation has been infinitesimal for all times in the past. By strengthening the differentiability assumptions for the functionals used to define simple materials a second and higher order theories of viscoelasticity were derived. Some predictions concerning the normal stresses derived from the second order theory of incompressible viscoelastic fluids are indicated. (Contractor's abstract)

1583

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

INTERMOLECULAR COUPLING OF VIBRATIONS IN MOLECULAR CRYSTALS: A VIBRATIONAL EXCITON APPROACH, by R. M. Hexter. Mar. 17, 1960 [41]p. incl. diagrs. table, refs. (AFOSR-TN-60-325) (AF 49-(638)542) AD 240661; PB 149830 Unclassified

Also published in Jour. Chem. Phys., v. 33: 1833-1842, Dec. 1960.

A vibrational exciton theory is developed which parallels in many ways the electronic exciton theory originally advanced by Davydov [Inst. of Phys., Ukranian Academy of Sciences, Kiev, Ukranian, SSR, 1951] and amplified by Craig and Hobbins [Jour. Chem. Soc., 539, 1955] and by Fox and Schnepp [Jour. Chem. Phys., v. 23: 767, 1955]. The kernel of the theory is the adoption, following Davydov again, of a transition dipole-transition dipole interaction as the potential which perturbs the isolated molecule energies and which thereby couples the motions of pairs of molecules in a crystal. As a result of the quantitative application of this theory, molecular dipole derivatives of several of the parallel modes of methyl chloride are obtained from the correlation field splittings of the corresponding fundamentals in the spectrum of solid methyl chloride. An isotope effect upon correlation field splittings is reported and is accounted for in terms of the same theory. A general method of testing the theory in terms of this isotope effect is suggested. The effect of intermolecular transition dipole coupling on intensities is derived and compared with the ratio of the dipole derivatives obtained from the correlation field splittings to those obtained from absolute intensity studies in the gas phase. The possible use of other bases for correlation field splittings is also discussed. (Contractor's abstract)

1584

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

INFRARED SPECTRUM OF SINGLE CRYSTALS OF LiOH, LiOD, AND LiOH·LiOD, by R. M. Hexter. Mar. 16, 1960 [34]p. incl. illus. diagrs. table, refs. (AFOSR-TN-60-404) (AF 49(638)542) AD 243658 Unclassified

Also published in Jour. Chem. Phys., v. 34: 941-947, Mar. 1961.

High resolution infrared absorption spectra of single crystals of LiOD and of the solid solution LiOH·LiOD are reported. These are compared with each other and with the spectrum of monocrystalline LiOH. Comparisons with the spectra of $Mg(OH)_2$ and $Ca(OH)_2$ are also made. The differences in selection rules for the 2 types of hydroxides are discussed together with differences in spectra to be expected upon changing the mass of the cation and upon deuterium substitution. The discussion

is in terms of the current theory of the spectra of such crystals. It is concluded that the complex spectrum of these minerals in the high frequency region (2000 - 5000 cm^{-1}) is entirely due to OH^- (or OD^-) ion motion. The motion is quite localized; the motions of the several OH^- ions of the crystal are poorly coupled. Difficulties with previous assignments due to unusual temperature dependencies of intensities are also discussed. The restricted rotational character of the localized motion of the OH^- ions, previously proposed, may be used to rationalize these difficulties and to qualitatively account for the existence and similarity of the spectra of all 3 materials. Finally the "rotational" model accounts well for the frequency shifts consequent on deuteration. (Contractor's abstract)

1585

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

SOLID STATE VIBRATIONAL SPECTRA OF THE METHYL AND METHYL-d_3 HALIDES, by M. E. Jacox and R. M. Hexter. Nov. 1, 1960 [27]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1420) (AF 49(638)542) AD 247745; PB 153549 Unclassified

Also published in Jour. Chem. Phys., v. 35: 183-188, July 1961.

The vibrational fundamentals of solid CH_3Cl, CH_3Br, and CH_3I and of their fully deuterated counterparts were examined at 77°K under high resolution. CH_3Cl^{35} was synthesized and its ν_3 spectrum compared to that of ordinary CH_3Cl, permitting the assignment of the CH_3Cl^{35} and CH_3Cl^{37} contributions in the ν_3 multiplet structure. The relative intensities of absorption in 1:1 CH_3X:CD_3X solid solutions were measured to test the relationship between splitting, frequency, and absorption intensity predicted by the dipolar correlation model. The test proved to be insensitive. A study of the ν_3 absorption of each component in CH_3Cl:CD_3Cl solid solutions throughout the concentration range shows that multiplet splitting persists at concentrations as low as 1%. (Contractor's abstract)

1586

Miami U. [Dept. of Mathematics] Coral Gables, Fla.

POLYNOMIAL INTERPOLATION IN POINTS EQUIDISTRIBUTED ON THE UNIT CIRCLE, by J. H. Curtiss. July 25, 1961, 19p. incl. refs. (AFOSR-TN-60-1424) (AF 49(638)862) AD 264052 Unclassified

Let $L_n(f; z)$ be the polynomial of degree at most n-1 found by interpolation in the distinct points $z_{nk} = e^{i\theta_{nk}}$, $k = 1, \ldots, n$, to a function f given on $|z| = 1$. It is known that a necessary and sufficient condition that $\lim_{n\to\infty} L_n(f; z) = f(z)$, $|z| \le 1$, for all f analytic on $|z| \le 1$, is that $\{\theta_{nk}\}$ be equidistributed on $[0, 2\pi]$. In nonanalytic cases, convergence has been established when z_{nk} is an n^{th} root of unity, but the behavior of $\{L_n\}$ with other spacings of the interpolation points is not clear. It is here proved that if θ_{nk}, $k = 1, \ldots, n$, are independent random variables each with a uniform probability distribution and if f satisfies certain mild smoothness restrictions on $|z| = 1$, then $E[L_n(f; z)] = (1/2\pi i) \int_{|t| = 1} [f(t)/(t - z)][1 - (z^n/t^n)]\, dt$, where L_n is found by interpolation to f in the random points $z_{nk} = e^{i\theta_{nk}}$. A simple example is constructed involving an equidistributed sample sequence $\{\theta_{nk}\}$ for which $L_n(f; z)$ diverges to infinity at each point z, $|z| < 1$, for at least one function f continuous on $|z| = 1$. (Contractor's abstract)

1587

Miami U. [Dept. of Mathematics, Coral Gables, Fla.]

A STOCHASTIC TREATMENT OF SOME CLASSICAL INTERPOLATION PROBLEMS, by J. H. Curtiss. [1960] [15]p. incl. refs. (AFOSR-TN-60-1425) (AF 49(638)862) AD 264018 Unclassified

Also published in Proc. Fourth Berkeley Symposium on Mathematical Statistics and Probability, California U., Berkeley (June 20-July 30, 1960), Los Angeles, California U. Press, 1961, v. 2: 79-93. (AFOSR-2135)

A probabilistic model is set up in which with probability one a sample sequence of points has an equidistribution property. It is found by use of the Jordan curve that for a function with a pole inside the curve but otherwise analytic, the value of $L_n(f,z)$ (a random variable) for z inside the curve will almost certainly not be near the value in which convergence takes place in deterministic roots-of-unity interpolation. Various asymptotic expected value results are also established.

1588

Miami U. Dept. of Physics, Coral Gables, Fla.

GAP LENGTH ANALYZER FOR NUCLEAR EMULSION TRACKS, by S. C. Bloch. [1958] [2]p. incl. diagr. (AF 49(638)97) Unclassified

Published in Rev. Scient. Instr., v. 29: 789-790, Sept. 1958.

Measurement of blob and gap lengths along tracks in nuclear emulsions provides a means of determining the energy loss of the ionizing particles. A system which reduces the role of the observer has already been

constructed in order to decrease the subjectivity and increase the speed of such measurements. This note describes an adjunct to this system, a gap length analyzer devised to provide simultaneously the number of gaps greater than any 8 predetermined minimum gap lengths. The counters utilized are physically grouped together in order to be photographed automatically at predetermined intervals along the track. A detailed operation of the apparatus is given.

1589

Miami U. [Dept. of Physics] Coral Gables, Fla.

STUDY OF ANTIPROTON INTERACTIONS, by M. Blau, C. F. Carter, and A. Perlmutter. Mar. 31, 1960 [16]p. incl. diagrs. tables. (AFOSR-TN-60-461) (AF 49(638)-97) AD 237447; PB 147786 Unclassified

A compilation of data is described which was obtained from the exposure of a stack of 200 Ilford G5 emulsions, of dimensions 4 in. x 6 in. x 400μ, to a separated beam of 670 $\frac{mev}{c}$ antiprotons, at the Bevatron of the University of California. The enriched antiproton beam of 700 $\frac{mev}{c}$ described by Chamberlain et al (Phys. Rev., v. 113: 1615, 1959) is degraded by an additional absorber to 670 $\frac{mev}{c}$ at the lead edge of the stack. The results are a compilation of the raw experimental data. The anti-proton annihilation paths are studied for pion, K-meson and other particle emission.

1590

Miami U. [Dept. of Physics] Coral Gables, Fla.

INTERACTIONS AND DECAYS OF HYPERONS PRODUCED IN K^- CAPTURE STARS AT REST, by M. Blau, C. F. Carter, and A. Perlmutter. May 31, 1960 [45]p. incl. diagrs. tables, refs. (AFOSR-TN-60-745) (AF 49-(638)97) AD 239956; PB 149332 Unclassified

The results of an investigation of hyperon interactions and decays are presented. Several inelastic interactions are described. The mean free path for nuclear interactions of charged Σ hyperons in emulsion is 11 ± 4 cm in the energy range 10 - 200 mev. Several possible examples are presented of a hyperon and pion produced in the interaction of a K^- at rest with 2 or more nucleons, suggesting that this mode of interaction is not as rare as was previously supposed. A table of positively identified Λ^0 hyperfragments is given. The decay of a Σ^+ via the proton mode and a Dalitz pair is described. Possible evidence is given for the decay of a Λ^0 hyperfragment via the π^+ mode, for the decay of a (Σ^+ p) hyperfragment, for the decay process $\Sigma^+ \rightarrow p + \gamma$, and for the capture of Σ^- with large energy release.

1591

[Miami U. Dept. of Physics, Coral Gables, Fla.]

[NUCLEAR EMULSION STUDIES] by M. Blau, C. F. Carter, and A. Perlmutter. Final rept. Feb. 1, 1957-May 31, 1960. (AFOSR-774) (AF 49(638)97) Unclassified

The present note constitutes an extremely curtailed outline of results obtained in an investigation of K^- interactions at rest in photographic emulsion. A total of 1739 (corrected to 1800) events were observed to determine the various modes of the K^- interaction. A portion of the results are published elsewhere (item no. 1590). It will be shown that the 1N mode of K^- interactions in emulsion nuclei is about 65% of the total, the remainder representing multi-nucleon captures. Also to be presented at a later date are estimates of the strengths of the various 1N- and 2N-reaction channels as well as the energy spectra of the emitted pions and hyperons.

1592

Miami U., Oxford, Ohio.

X-RAY STUDIES OF SALT SOLUTIONS, by H. L. Ritter. Dec. 1960, 65p. incl. illus. tables. (AFOSR-46) (AF 18-(600)485) AD 253967; PB 154730 Unclassified

Presented at meeting of the Inorg. Chem. Div. of the Amer. Chem. Soc., Atlantic City, N. J., Sept. 13-18, 1959.

Abstract published in 136th meeting of the Amer. Chem. Soc. Abstracts of Papers, 1959, p. 28n. (Title varies)

The Warren-Krutter-Morningstar analysis of x-ray patterns of liquids was applied to aqueous solutions of BaI_2, CdI_2 and CsI. The radical distribution curves of the BaI_2 solutions all show peaks in the region 3.7 to 3.9A of increasing prominence with increasing concentration. The Ba^{++} to I^- distance in crystalline BaI_2 ranges from 3.6 to 3.9A and the same distance in solution is taken as evidence of ion association therein. Separation of associated ions is found to be 3.70A. Areas under the peaks indicate the presence of ion clusters, 5 to 10 ions in the most concentrated solutions and fairly extensive pairing even in dilute. In the most concentrated solutions, next-nearest-neighbor separation in ion clusters appear to be 5.5 to 6.0A. Peaks in the radical distribution curves for CdI_2 solutions are much more prominent than in BaI_2. The Cd-I separation increases with concentration. A strongly developed peak near 4.6A suggests tetrahedral coordination in $CdI_4^=$ aggregates. The area under the 2.8A peak also indicates 4-coordination. Solutions of CsI show peaks more poorly developed than BaI_2. The presence of ion association at an interionic distance near 3.9A is evident.

1593

Michigan State U., East Lansing.

ON FLEXIBLE POWER-ASSOCIATIVE ALGEBRAS OF DEGREE TWO, by R. H. Oehmke. [1960] [8]p. (AF 49(638)511) Unclassified

Published in Proc. Amer Math. Soc., v. 12: 151-158, Feb. 1961.

The study of flexible power-associative algebras (Ann. Math., v. 68: 221-230, 1958) is continued here. The flexible identity is $(xy)x = x(yx)$. Let $\mathfrak{A}$ be a simple, flexible power-associative algebra of degree two (the maximum number of mutually orthogonal absolutely primitive idempotents), over an algebraically closed field of characteristic $\neq 2, 3, 5$. By a theorem on power-associative rings, $\mathfrak{A}$ can be decomposed, relative to an idempotent u, into $\mathfrak{A} = \mathfrak{A}_u(2) + \mathfrak{A}_u(1) + \mathfrak{A}_u(0)$, where $x \in \mathfrak{A}_u(\lambda)$ if and only if $ux + xu = \lambda x$. The main results are that if $\mathfrak{A}$ is u-stable, u being a primitive idempotent, then $\mathfrak{A}_u(2)$, $\mathfrak{A}_u(0)$ are isomorphic subalgebras of $\mathfrak{A}$, while if $\mathfrak{A}$ is stable, it is a noncommutative Jordan algebra. (Math. Rev. abstract, modified)

1594

Michigan State U. Dept. of Physics and Astronomy, East Lansing.

SEARCH FOR THE NATURAL ALPHA ACTIVITY OF TUNGSTEN, by G. B. Beard and W. H. Kelly. [1960] [12]p. incl. diagrs. (AFOSR-TN-60-114) (AF 49(638)10) AD 243173 Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 21, Jan. 27, 1960. (Title varies)

Also published in Nuclear Phys., v. 16: 591-596, June 1960.

Scintillation properties of $CdWO_4$ and $CaWO_4$ crystals have been studied and the crystals used in the search for natural alpha activity in tungsten. The relative scintillation efficiencies for gammas were found to be nearly the same for the 2 crystals and equal to approximately 0.1 that of NaI(Tl). An external source of 5.3 mev alpha particles produces approximately the same size pulses as 1.7 mev gammas. The scintillation decay times were found to be 3.3μs and 3.9μs for $CaWO_4$ and $CdWO_4$, respectively. Background measurements were made with a 3.8 cm diameter x 0.64 cm NaI(Tl) crystal. No indication of an alpha activity of tungsten was seen. It is concluded that any tungsten alpha activity present corresponds to a half-life of greater than $8 K \times 10^{17}$ y where K is the relative isotopic abundance of the isotope undergoing decay. This is in disagreement with the previously reported half-life of $2.2 K \times 10^{17}$ y.

1595

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

THE 85 MINUTE ACTIVITY OF Ba^{139}, by W. H. Kelly, G. B. Beard and others. [1960] [6]p. incl. diagrs. refs. (AFOSR-TN-60-259) (AF 49(638)10) AD 249159 Unclassified

Also published in Nuclear Phys., v. 19: 79-84, Sept. 1960.

The decay scheme of Ba^{139} has been studied using scintillation detectors. The half-life is found to be 85 ± 3 min. Beta-gamma and gamma-gamma coincidence measurements show this decay to consist of 3 beta groups of 2.38 and 0.95 mev, leading to the ground state and 2 excited states of La^{139}, the energies of the excited states being 0.167 ± 0.003 and 1.43 ± 0.05 mev. Transitions from these 2 states are to the ground state. Branching ratios of 0.72, 0.26 and 0.02 were found for the 2.38, 2.23 and 0.95 mev beta groups, respectively. Beta-gamma delayed coincidence measurements made on the 0.167 mev state show the half-life of this state to be 1.7 ± 0.2 ns. (Contractor's abstract)

1596

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

SCINTILLATION PROPERTIES OF $CaWO_4$ AND $CdWO_4$ CRYSTALS (Abstract), by G. B. Beard, W. H. Kelly, and M. L. Mallory. [1960] [1]p. [AF 49(638)10] Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 373, June 15, 1960.

Because of their high densities and high Z's, $CaWO_4$ and $CdWO_4$ crystals have relatively high photoefficiencies with the disadvantage of a long decay time which renders them poor for high counting rate experiments. The effect of temperature on the scintillation efficiencies and decay times of these crystals was studied to see if a more favorable operating temperature could be found. By using a Lucite light piper and a 6292 photomultiplier, the scintillation decay times were found to be 3.3 μsec for the $CaWO_4$ and 2.9 μsec for the $CdWO_4$ for both Po^{210} alphas and Cs^{137} γ rays at room temperature. The value for $CaWO_4$ agrees well with the results of Kallman and Brucker. Both decay times were found to

increase by about 20% when the crystals were cooled to liquid air temperature and to decrease by a factor of approximately 3 when warmed to 100°C. The apparent scintillation efficiencies, as determined from the relative pulse heights at the output of a cathode follower, were found to vary inversely with temperature. Preliminary measurements show the variations may not be monotonic. Curves will be presented and the results discussed.

1597

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

RESISTIVITY OF THIN METALLIC WIRES, by F. J. Blatt and H. G. Satz. 1960 [14]p. incl. diagrs. tables, refs. (AFOSR-4438) (AF 49(638)70) Unclassified

Presented at meeting of the Amer. Phys. Soc., California U., Berkeley, Dec. 29-31, 1960.

Also published in Helv. Phys. Acta, v. 33: 1007-1009, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 511, Dec. 29, 1960.

Measurements by Olsen on thin indium wires indicate that the residual and temperature dependent aspect of the resistivity increases with decreasing wire diameter. Olsen has suggested that small angle electron-photon scattering may be the cause of the observed effect by scattering electrons to the surface where they undergo diffuse reflection. An elementary approach to the problem is employed. Olsen's mechanism leads to an additional resistivity given by:

$$\rho_{ps} = (2\pi)^{1/3}\left(\frac{mv_F}{ne^2}\right)^{2/3}\left(\frac{T}{\theta_D}\right)^{2/3}[\rho_i^N(T)]^{1/3}(r)^{-2/3};$$

$r \ll l$, where v_F is the velocity at the Fermi energy and $\rho_i^N(T)$ is the ideal resistivity due to normal photon scattering. This expression is valid only if r (wire radius) is less than l (electron mean free path) in the bulk material. The above expression is in reasonable agreement with Olsen's results. (Contractor's abstract, modified)

1598

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

NUCLEAR MAGNETIC RELAXATION IN A STRONGLY ASSOCIATED LIQUID, by C. R. K. Murthy and R. D. Spence. [1960] [1]p. incl. diagrs. (AFOSR-TN-60-633) [AF 49(638)613] AD 456496 Unclassified

Also published in Jour. Chem. Phys., v. 33: 945, Sept. 1960.

Measurement of T_1 at 5 mc/sec for mixtures of phenyl isothiocyanate and diethylamine is presented. This mixture has a viscosity maximum at 50 mol-% and shows a corresponding minimum of T_1 at the same concentration. However a more detailed comparison of T_1 and viscosity shows that a more sophisticated analysis is required, as expected for this rather complex system.

1599

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

CONCENTRATION DEPENDENCE OF THE POLARIZATION AND RELAXATION TIME OF Al^{27} NUCLEI IN RUBY, by R. D. Spence and J. A. Cowen. [1959] 3p. incl. diagrs. (AFOSR-3582) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)613 and National Science Foundation) Unclassified

Also published in Jour. Chem. Phys., v. 32: 624-625, Feb. 1960.

In a previous experiment (item no. 1204, Vol. III) involving the Al^{27} nucleus in ruby containing 0.1% Cr it was not noted that the polarization built up and decayed with a rather long characteristic time. It is the aim of this work to discuss the dependence of the polarization time and enhancement on concentration. The data were taken on samples containing various amounts of Cr. In the 0.01% and 0.1% samples the enhancement was approximately 30 while in the 0.25% sample the enhancement was very slight. The relaxation time is 26 sec in the 0.01%, 2.6 sec in the 0.1%, and much less than 1 sec in the 0.25% sample. Therefore, it seems apparent that the polarization does not depend on the incremental polarization achieved each time this system sweeps through resonance.

1600

Michigan State U. Dept. of Physics and Astronomy, East Lansing.

INFRARED ABSORPTION WAVELENGTHS FOR SOLID LiH AND LiD, by W. B. Zimmerman and D. J. Montgomery. [1960] [1]p. (AFOSR-TN-60-1372) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)622 and Atomic Energy Commission) AD 246902 Unclassified

Also published in Phys. Rev., v. 120: 405, Oct. 15, 1960.

The infrared absorption spectrum of thin films of LiH and LiD was obtained at room temperature for the region 12.5-25 μ. The primary feature of the spectrum is a broad but definite absorption peak which occurs at 17.0 μ for LiH and at 22.4 μ for LiD. The observed ratio of the wavelengths is 1.32 ± 0.02, in excellent accord

with the ratio of the square root of the reduced masses, 1.33. This agreement is a confirmation of the elementary Born theory of lattice vibrations. (Contractor's abstract)

1601

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

EFFECT OF ISOTOPIC COMPOSITION ON INFRARED ABSORPTION OF SOLID LITHIUM HYDRIDE (Abstract), by W. B. Zimmerman and D. J. Montgomery. [1960] [1]p. (AFOSR-3554) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)622] and Atomic Energy Commission) Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 25-26, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 415, Nov. 25, 1960.

Infrared absorption spectra from 12.5μ to 25μ were obtained at room temperature for thin films of lithium hydride made from varying proportions of Li^6 and Li^7, H^1 and H^2. With suitable film thicknesses (0.03μ - 2μ), distinct and reproducible absorption maxima were observed. For the isotopically-pure compounds, a single absorption maximum was observed, the position shifting as the square root of the reduced mass. This behavior, in conformity with the predictions of the simple Born theory, has been observed in Li^6F and Li^7F, and in Li^7H^1 and Li^7H^2. For isotopically-impure compounds in which the departure from purity is slight, or in which the isotopes differ only slightly in mass, the behavior cannot be differentiated from that expected for a single isotopic species of the average isotopic mass. But otherwise the behavior is complicated, the shape of the patterns changing and the shifts following no obvious rule.

1602

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

METHOD FOR THE DETERMINATION OF ELASTIC CONSTANTS OF TRIGONAL CRYSTAL SYSTEMS, by W. G. Mayer and P. M. Parker. [1960] [2]p. (AFOSR-TN-60-1175) (AF 49(638)894) AD 261869 Unclassified

Also published in Acta Cryst., v. 14: 725-726, July 1961.

Expressions are given which relate the propagation velocities of mechanical waves to the elastic constants in single crystals of trigonal symmetry (characterized by six elastic constants). These expressions derive from the Christoffel equations without introduction of approximations. It is also shown how the expressions can be employed to evaluate the elastic constants in a relatively simple, straightforward manner from ultrasonic measurements. (Contractor's abstract)

1603

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

NOTE CONCERNING RUBY MASER-TYPE HAMILTONIANS, by P. M. Parker. [1960] [1]p. (AFOSR-TN-60-1488) [AF 49(638)894] AD 257370 Unclassified

Also published in Jour. Chem. Phys., v. 34: 1459-1460, Apr. 1961.

Simple relationships are shown in closed form between the eigenvalues and the physical constants of the spin Hamiltonian:

$$\mathcal{H}_s = g_{||}\beta H_z S_z + g_{\perp}\beta(H_x S_x + H_y S_y) + D[S_z^2 - \tfrac{1}{3}S(S+1)]$$

with spin quantum number S = 3/2. The relationships serve as a check on energy eigenvalues obtained from machine calculations. If the transitions for H and θ infer all four W_i's, the relationships can be used in data analysis.

1604

Michigan U. Dept. of Aeronautical and Astronautical Engineering, Ann Arbor.

STAGNATION POINT FLUCTUATIONS ON BODIES OF REVOLUTION WITH HEMISPHERICAL NOSES, by A. M. Kuethe, W. W. Willmarth, and C. H. Crocker. Final rept. June 1960, 26p. incl. illus. diagrs. tables, refs. (Rept. no. 02753-2-F) (AFOSR-TR-60-65) (AF 49(638)-336) AD 258348 Unclassified

The turbulent fields outside of the boundary layer near the noses of axially symmetric bodies with hemispherical noses were studied by means of the hot-wire anemometer. Measurements in a low turbulence wind tunnel over a range of Reynolds numbers show that the rms streamwise fluctuations in the nose region are larger than in the free stream. Large negative spatial correlation factors between streamwise fluctuations at ± 7° from the axis at low speeds and in a supersonic tunnel at Mach 2.45 indicate that the fluctuations in the nose region are coupled with a random motion of the stagnation point. The normalized energy spectra of the fluctuations at 7° are found to scale with the free stream wave number. These normalized spectra also show a shift toward lower frequencies compared with free stream turbulence. Possible connection between these phenomena and heat transfer measurements from bodies as affected by turbulence are pointed out. (Contractor's abstract)

1605

Michigan U. Dept. of Aeronautical and Astronautical Engineering, Ann Arbor.

RECENT RESULTS IN STANDING DETONATION WAVES, by J. A. Nicholls and E. K. Dabora. May 1960, 30p. incl. illus. diagrs. refs. (Rept. no. 2874-5-T) (AFOSR-TN-60-441) (AF 49(638)562) AD 238393; PB 148528 Unclassified

Also published in Eighth Symposium (Internat'l.) on Combustion, California Inst. of Tech., Pasadena (Aug. 28-Sept. 3, 1960), Baltimore, Williams and Wilkins Co., 1962, p. 644-655. (AFOSR-TR-60-127)

The method of establishing a hydrogen-air standing detonation wave (SDW) at the University of Michigan is reviewed briefly. Some recent experimental results are presented and interpreted in the light of theoretical treatment made here and elsewhere. The SDW is generated by mixing cold hydrogen with hot air supersonically, letting the mixture expand in the open jet of an underexpanded nozzle, and achieving combustion downstream of the normal shock which is characteristic of such jets. To assess the results, the shock Mach number, the stagnation temperature of the mixture, the mixture composition, and the pressure at the region of interest were determined. The results indicated that a one-dimensional treatment of the flow field near the wave is adequate. The experimental results consistently revealed a separation between the shock wave and the combustion zone. This is explained as an ignition time delay which can be deduced from consideration of the elementary chemical reactions and rates involved. The experimental results are compared with theory, and the agreement is quite good. This confirms the utility of the SDW method as a tool in the experimental study of chemical kinetics. Aerodynamic and chemical criteria important to establish and identify standing detonation waves are described. The aerodynamic criterion arises from jet structure and scale of the experiment, while the chemical criterion is based primarily on the temperature with its attendant relation to the explosion limit and ignition time delay. Consideration of these criteria allows identification of the waves as to strength. It is concluded that some strong detonation waves have been observed, but in most cases only a portion of the potential energy release influenced the shock wave. (Contractor's abstract, modified)

1606

Michigan U. Dept. of Aeronautical and Astronautical Engineering, Ann Arbor.

STABILIZATION OF GASEOUS DETONATION WAVES WITH EMPHASIS ON THE IGNITION TIME DELAY ZONE, by J. A. Nicholls. June 1960, 154p. incl. illus. diagrs. tables, refs. (Rept. no. 2874-6-T) (AFOSR-TN-60-442) (AF 49(638)562) AD 240064; PB 149305 Unclassified

A study was made of the dynamic conditions required to generate a standing gaseous detonation wave. Unheated H was mixed with heated air in the supersonic portion of an axisymmetric convergent-divergent nozzle. The nozzle was operated underexpanded so that acceleration of the mixture to the required high Mach number was realized in the open jet. Experiments were conducted over the mixture stagnation temperature range of about 1800° - 2430°R and a wide fuel-air range. The shock wave and flame were separated by a distance corresponding to the mixture ignition delay time (10 - 15 μsec, with the shortest times occurring at higher temperatures). At lower temperatures, where the separation between shock and flame was greater, there was no apparent interaction between shock wave and flame; at higher temperatures, the onset of combustion drove the shock wave upstream to a new stable position wherein the Mach number into the shock was lower. The latter type was considered to be a standing detonation wave. A theoretical analysis is presented of the ignition delay zone of H-O combustion which allows predictions of the rate of growth of all radical and water vapor concentrations behind the shock. In order to arrive at an explicit analytical expression for the ignition delay time, a value is introduced for the mol fraction of H atoms which is characteristic of this delay time. The delay time is dependent on the temperature, pressure, and composition of the mixture behind the shock as well as the pertinent reaction rate constants. The rate controlling reaction is: $O_2 + H \rightarrow OH + O$.

1607

Michigan U. Dept. of Chemical and Metallurgical Engineering, Ann Arbor.

THE EFFECT OF TENSILE STRESS ON DIHEDRAL ANGLES IN LEADED COPPER, by C. A. Stickels and E. E. Hucke. Mar. 31, 1960, 28p. incl. illus. diagrs. tables. (AFOSR-TN-60-385) (AF 49(638)422) AD 236091; PB 147004 Unclassified

Experiments were conducted to determine the effect of applied stress on dihedral angles of liquid lead in copper at 900°F. It was found that dihedral angles decrease with increasing stress in the center of test specimens, but that no apparent relation exists between the amount of stress applied and the dihedral angle observed nearer the surface of the specimen. The latter phenomena is attributed to oxygen penetration which changes angles by adsorption on interfaces. It was observed that stress levels resulting in specimen fracture were accompanied by migration of lead to the specimen surface and the fracture surface. It is postulated that when specimens are loaded above some critical value, liquid lead particles, originally present as discrete grains, spread out along grain boundaries. Thus, continuous films of lead are present over fairly large distances along grain boundaries. When one of these boundaries intersects the specimen surface, lead flows from the grain boundaries to the surface. Depending on local conditions, i.e., depth

of crack, stress concentration, etc., the grain boundary may then either close or open further to form a crack of the type leading to intercrystalline fracture. (Contractor's abstract, modified)

1608

Michigan U. Dept. of Chemical and Metallurgical Engineering, Ann Arbor.

THE EFFECT OF SURFACE TENSION OF A LIQUID METAL ENVIRONMENT ON THE FRACTURE STRENGTH OF SOLID METALS, by D. A. Kraai, S. Floreen and others. July 1960 [284]p. incl. illus. diagrs. tables, refs. (Rept. no. 2782-1-F) (AFOSR-TR-60-116) (AF 49(638)422) AD 242716
Unclassified

This report is divided into three sections. Each section covers a specific aspect of the relationship of surface and environments and their effects on the mechanical properties of solids. Each is discussed. Effects of some liquid metal environments on the fracture of copper: The following conclusions were made: (1) brittle intergranular fractures result when Cu is fractured in a liquid medium giving low strengths, (2) reproducible values for the ultimate strength of Cu wire in different liquid metal environments can be obtained only when good contact exists between the Cu and its environment, (3) the ultimate and fracture strengths of Cu in Pb-Bi environments are not affected by the length of time of immersion of the Cu in a stress-free condition prior to fracture, (4) the fracture strength of Cu can be represented as a function of Cu-liquid metal interfacial energy, and (5) liquid metals immiscible with Cu tend to lower the strength of Cu more than do elements which form Cu compounds. The effect of strain on the surface energy of solids: It was concluded that: (1) the surface free energy and grain boundary energy of a solid change with elastic strain as shown by $f^S = f^S_0 + K\epsilon^2$ and $f^B = f^B_0 + j\epsilon^2$, (2) changes of surface tension with elastic strain may be shown by $\gamma = \gamma_0 + K\epsilon^2$, (3) the values of k and j may be determined by measurements of the slopes of stress-strain curves in the elastic region, (4) the values of k and j are on the order of 10^9 and 10^8 ergs/cm^2, respectively. The effect of tensile stress on dihedral angles in leaded copper: The dihedral angles decrease with increasing stress in the center of test specimens, but no apparent relation exists between the amount of stress applied and the dihedral angle observed nearer the surface of the specimen. Stress levels resulting in specimen fracture were accompanied by migration of Pb to the specimen surface at the fracture surface.

1609

Michigan U. Dept. of Chemical and Metallurgical Engineering, Ann Arbor.

CHEMICAL SINTERING OF BERTHOLLIDE COMPOUNDS, by G. Parravano. Jan. 1961, 18p. incl. diagrs. (Rept. no. 2832-12-T) (AFOSR-TN-60-109) (AF 49-(638)493) AD 251069; PB 154732 Unclassified

Also published in Reactivity of Solids; Proc. Fourth Internat'l. Symposium, Amsterdam (The Netherlands) (May 30-June 4, 1960), Amsterdam, Elsevier, 1961, p. 83-90.

The role of solid state reactions in the sintering of berthollide compounds is examined. Under some conditions, the free energy change of the chemical transformation is the determining factor for the welding together of particulate non-stoichiometric solids. A diffusional transfer of matter in the solid controls the chemical reaction and, consequently, sintering. Mathematical expressions for diffusion and sintering in the simple case of 2 spherical particles are presented and the results compared with experimental data on the sintering of zinc oxide microspheres. Equations for the shrinkage of pores as a result of a chemical reaction are also presented. (Contractor's abstract)

1610

Michigan U. Dept. of Chemical and Metallurgical Engineering, Ann Arbor.

SINTERING OF TITANIUM DIOXIDE, by H. M. O'Bryan, Jr. and G. Parravano. [1960] [17]p. incl. illus. diagrs. tables. (AFOSR-TN-60-626) (AF 49(638)493)
Unclassified

Also published in Powder Metallurgy; Proc. Internat'l. Conf., New York (June 13-17, 1960), New York, Interscience Publishers, 1961, p. 191-199.

Experiments were performed on the rate of growth of the neck formed between titanium dioxide single crystal spheres, at constant temperature and different surrounding gas atmospheres. These included air and mixtures of $H_2 + H_2O$ from 1:1 to 1:20. The temperature range investigated was 900° to 1350°C. A kinetic analysis of the data shows that the predominant contribution to the sintering of the microspheres stems from a plastic flow mechanism. Supporting qualitative evidence for this condition is presented. Whisker growth during sintering of titania was observed and the effect of this growth on sintering is discussed. (Contractor's abstract)

1611

Michigan U. Dept. of Chemical and Metallurgical Engineering, Ann Arbor.

SURFACE HETEROGENEITY: A MODERN VERSION,

by G. Parravano. Jan. 1961, 19p. incl. diagrs. refs. (Rept. no. 2832-13-T) (AFOSR-TN-60-1460) (AF 49-(638)493) AD 251068; PB 154783 Unclassified

Also published in Gazz. Chim. Ital., v. 91: 467-478, 1961.

Surfaces of real crystals possess sites with varying affinity for gas phase species. Variations in thermodynamic affinity extend in both time and location of the surface. The result is a surface with a dynamic distribution of energy. The distribution function is a basic factor in controlling the physicochemical behavior of the surface. The combined effects of dislocations and whiskers growing on the surface provide a satisfactory model for the dynamic heterogeneity of surfaces. The kinetics and mechanisms of whisker growth are discussed in some detail, and the implications of the growth kinetics on surface heterogeneity are emphasized. In addition, the role of filamentary growth on sintering of high area catalysts is briefly pointed out. (Contractor's abstract)

1612

Michigan U. Dept. of Chemistry, Ann Arbor.

SPECTROSCOPIC EVIDENCE FOR GASEOUS BENZYNE, by R. S. Berry, G. N. Spokes, and R. M. Stiles. Oct 1960, 4p. incl. diagr. table. (Rept. no. 02878-2-P) (AFOSR-TN-60-991) (AF 49(638)538) AD 244841 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 5240-5241, Oct. 5, 1960.

A volatile precurser of diphenylene from the flash photolysis of benzene-diazonium-2-carboxylate was identified as benzyne (1,2-dehydrobenzene). The assignment was made after consideration of the source of the species, its ultraviolet spectrum, and the rapidity with which it forms gaseous diphenylene. The spectrum of the intermediate compound was divided into several regions: (1) very weak absorption at wavelengths greater than 270mμ; (2) slightly stronger absorption from 270 to 255 or 250mμ; (3) distinctly stronger absorption from 250 to 235mμ; and (4) very strong absorption beyond 2300A. A broad maximum was found between 238.5 and 241.5mμ. Speculative assignments of bands were made by drawing an analogy with the spectrum of pyridine. The absorption in regions (1) and (2) would be assigned to $n \rightarrow \pi^*$ excitation. The absorption in the 240-mμ region could be assigned to a $\pi \rightarrow \pi^*$ transition.

1613

Michigan U. Dept. of Chemistry, Ann Arbor.

MOLECULAR FRAGMENTS IN SHOCK WAVES, by R. S. Berry. Final rept. Aug. 1960 [31]p. incl. illus. diagrs. tables, refs. (Rept. no. 02878-1-F) (AFOSR-TR-60-118) (AF 49(638)538) AD 244842; PB 152612 Unclassified

The following work is described: (1) the design of an apparatus used for absorption spectroscopy of materials behind shock fronts, with provision for multiple-pass optics; (2) preliminary results based on shocks through alkali halides, giving evidence of dissociation and formation of diatomic alkali metal van der Waals molecules; (3) results on the fragmentation of diborane behind shock fronts, showing the formation, possibly, of an unstable polyatomic intermediate, then BH and finally polymeric species; and (4) preliminary results of flash photolysis of benzene, 2-diazonium carboxylate, directed toward the identification of benzyne, C_6H_4. (Contractor's abstract)

1614

Michigan U. [Dept. of Electrical Engineering] Ann Arbor.

MATHEMATICAL MODELS IN SENSORY PERCEPTION, by W. P. Tanner, Jr. [1960] [24]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)369 and Signal Corps) Unclassified

Published in Bionics Symposium, Dayton, Ohio (Sept. 13-15, 1960), Wright-Patterson Air Force Base, Wright Air Development Div., 1960, p. 263-286. (WADD-TR-60-600)

An outline of 1 type of program which might lead to the development of the basic scientific knowledge essential to the growth of bionics is discussed. The work divided into 4 phases covers the development of mathematical models specifying optimum performance, the design of experiments and the interpretation of data within this framework, a review of the data so far collected, and the development of a descriptive model of the hearing process without reference to specific neural mechanisms. The model described may serve a purpose in describing some nervous system operations.

1615

Michigan U. [Dept. of Electrical Engineering] Ann Arbor.

AMPLITUDE DISCRIMINATION AS A FUNCTION OF THREE VARIABLES (Abstract), by F. R. Clarke. [1960] [2]p. [AF 49(638)369] Unclassified

Presented at Fifty-ninth meeting of the Acoust. Soc. Amer., Brown U., Providence, R. I., June 9-11, 1960.

Published in Jour. Acoust. Soc. Amer., v. 32: 931-932, July 1960.

Two alternative forced-choice experiments were conducted in which the observers were required to report which of 2 sinusoidal signals had the larger amplitude. Three variables were systematically studied: (1) the level of the background noise; (2) the level of the base carrier; and (3) the energy of the difference signal. Data are reported for 4 observers. These data are fit by equations of the form $(d')^2 = \eta 2E/(N_0 + kV_B^2)$,

where E is the energy of the difference signal, V_B^2 is proportional to the power of the base carrier, and N_0 is the noise power per unit bandwidth. Both η and k are parameters describing the individual observers. Although these studies were analyzed in the framework of the theory of signal detectability, results are reported using the traditional percent of correct responses as a dependent variable.

1616

Michigan U. [Dept. of Electrical Engineering] Ann Arbor.

MEMORY AND THE PSYCHOPHYSICAL FUNCTION (Abstract), by W. P. Tanner, Jr. [1960] [1]p. [AF 49-(638)884] Unclassified

Presented at Sixtieth meeting of the Acoust. Soc. Amer., San Francisco, Calif., Oct. 20-22, 1960.

Published in Jour. Acoust. Soc. Amer., v. 32: 1505, Nov. 1960.

The form of the psychophysical function can be accounted for by assuming an imperfect memory. A theoretical exposition of the subject is presented, and 3 memory components are isolated experimentally. These components are memory for (1) amplitude, (2) starting time and duration, and (3) frequency and phase. An equation is presented which leads to consistency between predictions of the signal detectability and empirical results for the form of the psychophysical function.

1617

Michigan U. Dept. of Mathematics, Ann Arbor.

EXTENSION OF LOCAL AND MEDIAL PROPERTIES TO COMPACTIFICATIONS WITH AN APPLICATION TO CECH MANIFOLDS, by R. L. Wilder. Sept. 1960, 21p. incl. diagr. refs. (Rept. no. 0300, 03597-1-T) (AFOSR-TN-60-1062) (AF 49(638)104 and AF 49(638)-774) AD 246626; PB 153266 Unclassified

Also published in Czech. Math. Jour., v. 11: 306-318, 1961.

Of central importance in topology and its applications have been the manifolds of various dimensions. In 1936, in a paper published by E. Cech (Proc. Nat'l. Acad. Sci., v. 22: 110-111, 1936) proposed for study a type of manifold which embodied a condition that every point have a neighborhood whose one-point compactification is an orientable closed manifold. The chief question now studied relates to the implication of this condition if applied to arbitrarily small neighborhoods of a point. This necessitates a search for conditions under which a locally compact space, which has a given type of local connectedness, will preserve this under compactifications. Necessary and sufficient conditions are obtained which apply to both the one-point and to the Freudenthal compactifications. It is found that if a manifold satisfies the Cech condition for arbitrarily small neighborhoods of a point x, then x has arbitrarily small neighborhoods that are r-acyclic (in terms of compact homology) in all dimensions r. The question whether all manifolds of the type in current use have such neighborhoods, is answered by providing an example of one which does not. (Contractor's abstract)

1618

Michigan U. Dept. of Mathematics, Ann Arbor.

ABSOLUTELY CONVERGENT POWER SERIES, by F. Bagemihl and G. Piranian. June 1960, 9p. (Rept. no. 2913-2-T) (AFOSR-TN-60-574) (AF 49(638)633) AD 239274 Unclassified

Also published in Annales Univ. Scient. Budapestinensis de Rolando Eotvos Sect. Math., v. 3-4: 27-34, 1960/61.

Power series exist that map the unit circle C onto a Peano curve and that converge absolutely on C. A new example is exhibited which has the additional property that it maps the unit disk D onto a Riemann surface of finite area. The possibility that a power series converges absolutely on C and maps C onto a Jordan curve that has both rectifiable and nonrectifiable arcs is shown. A number of unsolved problems are stated. (Contractor's abstract)

1619

Michigan U. Dept. of Mathematics, Ann Arbor.

ASYMMETRIC PRIME ENDS, by E. F. Collingwood and G. Piranian. Oct. 1960, 9p. incl. diagrs. (Rept. no. 2913-3-T) (AFOSR-TN-60-992) (AF 49(638)633) AD 246573; PB 153200 Unclassified

Each simply connected domain in the plane has at most countably many prime ends whose right and left wings do not coincide. To each countable set E on the unit circle C, there corresponds a function which is holomorphic and univalent in the unit disk D and which has the property that it carries each point of E and no point of C E onto a prime end with unequal wings. (Contractor's abstract)

162

Michigan U. Dept. of Mathematics, Ann Arbor.

A CONVERSE OF A THEOREM OF R. H. BING AND ITS GENERALIZATION, by R. L. Wilder. Sept. 1960, 9p. (Rept. no. 03597-2-T) (AFOSR-TN-60-1071) (AF 49-(638)774) AD 246627; PB 153267 Unclassified

Also published in Fundamenta Math. (Poland), v. 50: 119-122, 1961.

R. H. Bing announced that in 3-space, every topological 2-sphere S is almost free in that for every positive number e there exists a Cantor set C in S and an e-transformation of S into a set which meets S only in C. It seems highly probable that the general 2-manifold will have the same property. A converse of this is shown and a new positional characterization of the manifold is obtained. An analogous sufficient condition is also provided for the general n-dimensional Euclidean space. (Contractor's abstract)

1621

Michigan U. Dept. of Physics, Ann Arbor.

EXCITATION TEMPERATURE OF CHROMIUM IN THE SHOCK TUBE, by G. Charatis and T. D. Wilkerson. [1959] [2]p. (AFOSR-TN-60-101) (AF 49(638)439) Unclassified

Also published in Phys. Fluids, v. 2: 578-579, Sept.-Oct. 1959.

Measurements of relative intensities of CrI lines between 4500 and 5000A, excited by reflected shock waves through neon containing a trace of $Cr(CO)_6$, are used to derive excitation temperatures. Results tend to be low, especially at high temperatures (10^4 °K) where the excitation temperature is only 0.6 of the expected gas kinetic temperature. Three possible causes are suggested.

1622

Michigan U. Dept. of Physics, Ann Arbor.

HYDRODYNAMIC ASPECTS OF SHOCK TUBE SPECTROSCOPY, by O. Laporte and T. D. Wilkerson. [1960] [7]p. incl. illus. diagrs. table, refs. (AFOSR-TN-60-1196) [AF 49(638)439] AD 262064 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 50: 1293-1299, Dec. 1960.

Time-resolved spectroscopic observations with the shock tube are described. Emission spectra are recorded for the high-temperature gas behind the shock reflected from the closed end of the tube. Simultaneous observations are made of the hydrodynamic variables. The state of the emitting gas is predicted by hydrodynamic theory and correlated with the observed spectrum. Deviations from ideal theory caused by viscosity and heat conduction are recognized, and their influence upon pressure and temperature is appraised by direct measurement. (Contractor's abstract)

1623

Michigan U. [Dept. of Physics] Ann Arbor.

STUDIES OF THE LUMINOUS GAS BEHIND REFLECTED SHOCK WAVES (Abstract), by T. D. Wilkerson. [1960] [1]p. [AF 49(638)439] Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 362, June 15, 1960.

Measurements of pressure and temperature in a shock tube are described. The results bear directly on the calibration of the hot gas behind the reflected shock as a spectroscopic source. On the basis of a few spot-check experiments (covering the ranges of 0.5 to 10 atm in total pressure P and 4000 to 10,000°K in kinetic temperature T), the conditions of the gas near the end wall of the shock tube appear to be very close to those predicted from the primary shock speed by the usual theory. This test of the theory was required in view of the evident nonuniformities of the flow fields arising from boundary layers on the walls. The primary shock waves (Mach 6 to 7) were generated by the expansion of high-pressure hydrogen into neon at initial pressures of 7 to 30 mm Hg. P was measured with SLM-Kistler PZ 6-S quartz transducer, and T was computed from velocity measurements on the reflected shock and on the fluid to both sides of it. These values of P and T were compared with the values independently calculated from the primary shock speed. All velocities were measured by x-t photography of the luminosity induced by additives. A few microns of CH_4 sufficed to make the shock fronts visible by Swan band emission of C_2, and $CsNO_3$ dust was used to create luminous spots moving with the flow speed.

1624

Michigan U. Engineering Psychology Group, Ann Arbor.

BEHAVIORAL DECISION THEORY, by W. Edwards. [1960] [26]p. incl. refs. (AFOSR-TN-60-967) (AF 49-(638)769) AD 252902 Unclassified

Also published in Ann. Rev. Psychol., v. 12: 473-498, 1961.

The psychological and economic theories on riskless and risky decision making, the theory of games, and the experiments relating to these theories are discussed for the period 1954 through April 1960. The numerous investigations in the published literature are used as the source material for the discussions. In reviewing the various books, the author correlates them to his own studies and those of others. The subject matter is grouped under the subtitles of (1) Static models and related experiments, (2) Research on utility, (3) Research on subjective probability, (4) Stochastic theories of

choice, (5) Application of static decision making, (6) Variance preferences, (7) Personality variables in decision making, (8) Dynamic decision making, and (9) Experimental games. The literature cited seems to be a fine representation of the subject matter.

1625

Michigan U. Engineering Research Inst., Ann Arbor.

[FACTORS CONTROLLING NONLINEAR PHENOMENA IN FERROMAGNETIC AND FERROELECTRIC CERAMICS], by D. M. Grimes. Final rept. Aug. 1960 [7]p. incl. refs. (AFOSR-155) (AF 18(603)8) Unclassified

The principal results of this contract are contributions to the understanding of effects in ferromagnetic and ferroelectric materials such as variation of reversibility and reaction mechanics. A new knowledge and more complete understanding of the process of technical saturation and the associated resulting change in magnetic properties was obtained. The variation of susceptibility and differential magnetostriction with magnetization was clarified. Zinc ferrite was obtained in a pure enough form so that direct thermodynamic results could be and were produced. The reaction mechanism and kinetics of mixed spinels were studied. As a result the importance of various parameters to spinel formation were isolated. Since the completion of this report it is reported that the author attended the Conference on Magnetism and Magnetic Materials during which valuable exchanges occurred in formal and informal discussions among researchers in the field. A new phase of solid state research into the behavior of materials that exhibit non-linear ferroelectric as well as ferromagnetic properties was also begun. A brief report of progress on this project is also presented.

1625A

Michigan U. [Engineering Research Inst.] Ann Arbor.

VARIATION OF PERMITTIVITY WITH ELECTRIC FIELD IN PEROVSKITE-LIKE FERROELECTRICS, by H. Diamond. [1960] [7]p. incl. diagrs. refs. (AFOSR-J511) [AF 18(603)8] AD 414054 Unclassified

Also published in Jour. Appl. Phys., v. 32: 909-915, May 1961.

A model is considered for the case of polycrystalline ferroelectrics in which each crystallite is presumed to behave according to a free-energy function of the type formulated by A. F. Devonshire for $BaTiO_3$. The Curie temperatures for the individual grains are taken in a Gaussian distribution about some chosen temperature. The permittivity is obtained by averaging with this distribution over all of the crystallites. In accordance with the free-energy function, it is assumed that the electric field induces a ferroelectric axis in those crystallites of the distribution which are not ferroelectric at a given temperature. On the basis of experimental evidence, 90° reorientation of domains in the ferroelectric part of the distribution is presumed to be negligible for semistatic and dynamic fields. Despite the seemingly severe restriction imposed by the latter assumption, a large field sensitivity is predicted. Agreement between the theory and experimental data is excellent for both parallel and transverse fields. It is concluded that the variation of incremental permittivity is associated with an induced ferroelectric state rather than being directly a property of domain process, and that a large variation with field must necessarily be accompanied by strong thermal sensitivity. (Contractor's abstract)

1626

Michigan U. [Engineering Research Inst.] Ann Arbor.

THEORY OF THE ELECTRIC FIELD VARIATION OF INCREMENTAL PERMITTIVITY IN PEROVSKITE-TYPE FERROELECTRICS (Abstract), by H. Diamond. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)8] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 57, Jan. 27, 1960.

A model is considered for the case of polycrystalline ferroelectrics in which each crystallite is presumed to behave according to Devonshire's free energy function. The Curie temperatures for the individual grains are taken in a Gaussian distribution about some chosen temperature. The permittivity is obtained by averaging with this distribution over all of the crystallites. In accordance with the free energy function, it is assumed that the electric field induces a ferroelectric axis along the field direction in those crystallites of the distribution which are not ferroelectric at a given temperature. On the basis of experimental evidence, domains in the ferroelectric part of the distribution are presumed to be immobile. Despite the seemingly severe restriction imposed by the latter assumption, a large field sensitivity is predicted. Agreement between the theory and the experimental data is excellent for both parallel and transverse fields. It is concluded that the variation of incremental permittivity is associated with an induced ferroelectric state rather than being directly a property of domain processes, and that a large variation with field must necessarily be accompanied by strong thermal sensitivity.

1627

Michigan U. [Engineering Research Inst.] Ann Arbor.

ON THE MICROWAVE DIELECTRIC DISPERSION AND LOSS IN HIGH-PERMITTIVITY FERROELECTRICS (Abstract), by H. Diamond. [1960] [1]p. [AF 18(603)8] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 83, Jan. 27, 1960.

Measurements of complex permittivity vs frequency have been made on several ferroelectrics from 0.5 mc to 4000 mc. Dynamic permittivity spectra of $BaTiO_3$ crystals with the polar axis aligned with, and also transverse to, the high-frequency fields show a complex dimensional resonance spectrum in the 1-mc frequency range. For frequencies higher than 20 mc both the parallel and transverse permittivity is reduced to about 1/2 of that at the low frequency limit, consistent with the Devonshire theory for the clamping of single crystals. Microwave data to 4000 mc fail to reveal further dispersion. On the other hand, data on several polycrystalline ferroelectric compositions including $BaTiO_3$, $Ba_xSr_{1-x}TiO_3$, $PB_xSr_{1-x}TiO_3$, and $Cd_2Nb_2O_7$ show substantial reductions in permittivities at microwave frequencies. The disparity between the single crystal and polycrystal data is ascribed directly to the effects of electrostrictive and piezoelectric interactions at grain boundaries and domain walls. The effect of such loss mechanisms on reducing the apparent permittivity at high frequencies is shown to be more pronounced the higher the permittivity of the dielectric. Data are also included on the change in incremental permittivity and loss at microwave frequencies for polycrystalline ferroelectrics under static and low-frequency biasing fields.

1628

Michigan U. [Engineering Research Inst.] Ann Arbor.

EXPERIMENTS ON TRANSITION TO TURBULENT FLOW IN A TUBE (Abstract), by A. M. Kuethe and K. R. Raman. [1959] [1]p. [AF 18(603)34] Unclassified

Presented at meeting of the Amer. Phys. Soc., Ann Arbor, Mich., Nov. 23-25, 1959.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 132, Mar. 4, 1960.

Hot-wire measurements of velocity fluctuations, Reynolds stresses, and shearing stresses at the wall in the transition region of a tube are presented. Transition was excited by annular projections at the wall and by annular wire rings at different radial positions in the fully developed laminar flow 620 diam downstream of the entrance. The results show that the transition Reynolds number is a function of the magnitude of the disturbance. Measurements at a Reynolds number of 6000 show further that the velocity fluctuations, Reynolds stresses, and the wall shearing stress during the early stages of transition can reach values considerably higher than those in the fully developed turbulent flow. Implications are pointed out regarding possible causes for the high temperature recovery factor during transition in high speed flow over surfaces.

1629

Michigan U. Research Center for Group Dynamics, Ann Arbor.

STUDIES IN SELECTION LEARNING. I. THE EFFECT OF SELECTION PROCESSES ON ACQUISITION AND RETENTION, by E. Burnstein. Sept. 1959, 22p. incl. diagr. tables, refs. (Technical rept. no. 1) (AFOSR-TN-60-11) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)367 and National Science Foundation under G-4951) AD 230195; PB 145101 Unclassified

An examination of a type of learning called selection learning was made. The paradigm of selection learning has the following characteristics. Individuals are presented with a list of items to learn, containing a number of incidental items which are to be ignored. The intentional items are characterized by an attribute called the selection cue, which permits them to be discriminated from the incidental items. Selection learning differs from ordinary verbal rote learning in that the latter procedure does not utilize incidental items. In an exploratory experiment no differences in acquisition between selectors and rote learners were obtained. After 1 hr of interpolated activity, however, selectors retained significantly more items than subjects who learned under the traditional rote learning procedure. It was hypothesized that there exist 2 factors in selection learning which cancel each other in acquisition, thus preventing differences in performance from appearing. One factor, facilitation of learning, was hypothesized to be a direct function of the informativeness of the selection cue. The other, interference with recall of international items, was hypothesized to vary directly with the amount of learning of incidental items. It was further hypothesized that the effects of interferences dissipate more rapidly than the effects of facilitation. (Contractor's abstract)

1630

Michigan U. Research Center for Group Dynamics, Ann Arbor.

STUDIES IN SELECTION LEARNING. II. THE EFFECT OF INFORMATIVE AND UNINFORMATIVE CUES ON THE ACQUISITION AND RETENTION OF INTENTIONAL ITEMS, by E. Burnstein. Oct. 1959, 9p. incl. diagr. table. (Technical rept. no. 2) (AFOSR-TN-60-263) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)367 and National Science Foundation under G-4951) AD 231032; PB 146311 Unclassified

The purpose of this study was to examine the effect of the informativeness of the selection cue on acquisition and retention under conditions of selection learning. In selection learning, unlike ordinary verbal rote learning,

subjects learn a set of items which are interspersed among certain incidental items to be ignored. The selection cue differentiates between the intentional and incidental items. The findings indicate a significant effect in memory as a result of the informativeness of the selection cue. In the informative condition the intentional items consisted of 2 odd digit numbers and 1 even digit number; the incidental items, of 3 even digit numbers. Subjects were instructed to learn only the former. In the uninformative condition both sets of items were the same but the intentional items were preceded by 3 taps and incidental by 2 taps. Subjects were instructed to learn only those preceded by 3 taps. No mention of the digit composition of the items was made. The findings show that when the cue is uninformative, performance in acquisition and retention is the same as in ordinary verbal rote learning. With informative cues, however, a significant gain in recall is obtained. (Contractor's abstract, modified)

1631

Michigan U. Research Center for Group Dynamics, Ann Arbor.

STUDIES IN SELECTION LEARNING. III. FACILITATION AND INTERFERENCE EFFECTS IN SELECTION LEARNING, by E. Burnstein. Oct. 1959, 15p. incl. diagrs. tables, (Technical rept. no. 3) (AFOSR-TN-60-264) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)367 and National Science Foundation under G-4951) AD 233378; PB 146310
Unclassified

Two experiments were conducted to demonstrate directly facilitation and interference effects in selection learning. The selection learning paradigm involves the simultaneous presentation of intentional and incidental items with the requirement that the subject learn only the intentional ones. In experiment 1 an attempt was made to improve the performance of selection learners in acquisition by reducing interference without simultaneously reducing facilitation. Informative cue selection learners were compared for acquisition rates with uninformative cue selection learners, and the results demonstrated superior acquisition rate for the former. In experiment 2 an attempt was made to reduce acquisition rates of the selection learners by requiring short response latencies. Selection learners utilizing informative cues and uninformative cues were compared with ordinary rote learners. The results showed marked superiority of rote learners over selection learners in acquisition. Moreover, selection learners with uninformative cues showed performance in acquisition superior to that of selection learners with informative cues. In retention tests some evidence for the differential dissipation of interference effects was obtained. The most "forgetting" was noted in rote learners, next in selection learners with uninformative cues, and least in selection learners with informative cues. (Contractor's abstract, modified)

1632

Michigan U. Research Center for Group Dynamics, Ann Arbor.

STUDIES IN SELECTION LEARNING. IV. THE ACQUISITION AND RETENTION OF INCIDENTAL ITEMS IN SELECTION LEARNING, by E. Burnstein. Oct. 1959, 8p. incl. diagr. tables. (Technical rept. no. 4) (AFOSR-TN-60-265) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)367 and National Science Foundation under G-4951) AD 233379; PB 146231
Unclassified

Previous studies on selection learning have demonstrated superior retention of selection learners utilizing informative cues (IS) to those utilizing uninformative cues (US). These findings were accounted for by assuming that interference due to the learning of incidental items dissipates during the interpolated interval. The hypothesis was advanced that selection learners using informative cues will show higher incidental learning than selection learners using uninformative cues, but that they will also show a faster rate of forgetting of the incidental material. Experimental confirmation was obtained with respect to the differences in acquisition. Although the results pertaining to the retention of incidental items were in the predicted direction they failed to reach the acceptable level of significance. (Contractor's abstract)

1633

Michigan U. Research Center for Group Dynamics, Ann Arbor.

STUDIES ON DRIVE AND INCENTIVE IN PERCEPTION. I. SOME EFFECTS OF DRIVE ON STIMULUS GENERALIZATION, by D. Dorfman. Feb. 1960, 15p. incl. diagrs. tables, refs. (Technical rept. no. 5) (AFOSR-TN-60-326) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)367 and National Science Foundation under G-4951) AD 233777; PB 146641
Unclassified

Also published in Psychol. Repts., v. 9: 87-98, 1961.

Some implications of the hypothesis that the effective or perceived intensity of a stimulus is an increasing function of drive level were tested. Implications were derived for stimulus-generalization data. Thirty subjects were trained to respond "win" to a particular tactual stimulus. Fifteen Ss were trained under low drive (sound) and tested for generalization of the "win" response under both low and high drive conditions, and fifteen Ss were trained under highdrive; tested under similar conditions. The experimental results confirmed the hypothesis: (1) that an increase in drive level from training to test resulted in a shift of the generalization gradient toward the lesser physical stimulus intensitives; and (2) that a decrease in drive level from training to test resulted in a shift of the generalization gradient toward the greater physical stimulus intensities. (Contractor's abstract)

1634

Michigan U. Research Center for Group Dynamics Ann Arbor.

STUDIES ON DRIVE AND INCENTIVE IN PERCEPTION. II. THE EFFECT OF DRIVE PRODUCED BY PROPRIOCEPTIVE STIMULATION ON GENERALIZED RESPONSES TO LOUDNESS AND PITCH, by A. H. Matlin. July 1960, 32p. incl. diagrs. tables, refs. (Technical rept. no. 6) (AFOSR-TN-60-1054) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)367 and National Science Foundation under G-4951) AD 242399 Unclassified

An attempt was made to determine the validity of the hypothesis that perceived stimulus intensity is a function of drive multiplied by the physical stimulus intensity. The effects of proprioceptive stimulation on generalization gradients along qualitative and quantitative dimensions were investigated. The findings regarding the quantitative dimension gradients were consistently opposite to what had been predicted. The predictions concerning the qualitative dimension gradients were in general confirmed. Explanations both within and outside the D x S framework were set forth to account for the significant reversal of the expected effect of drive on the quantitative dimension gradients. (Contractor's abstract)

1635

Michigan U. [Speech Research Lab.] Ann Arbor.

FOUNDATIONS OF PHONEMIC THEORY, by G. E. Peterson and F. Harary. [1960] [27]p. incl diagrs. tables, refs. (AFOSR-TN-60-1203) (AF 49(638)492) Unclassified

Also published in Structure of Language and Its Mathematical Aspects; Proc. Twelfth Symposium in Appl. Math., New York (Apr. 14-15, 1960), Providence, Amer. Math. Soc., v. 12: 139-165, 1961.

Preliminary ideas with accompanying definitions are presented on the subject of a phonemic theory. A definition of linguistic units is given to which are applied essential background mathematics. A phonetic theory is then developed defined as a description of the physiological formations which may be used in speech production, the transformations of these formations to acoustical speech waves, and the basic properties of the resulting acoustical waves. This theory is essential to a phonemic theory which specifies the organization of physiological time functions of speech into classes of basic linguistic elements. Other basic requirements imposed upon the phonemic theory and their meanings are also presented such as completeness, linguistic independence, speech-to-symbol correspondence, and symbol recoverability. Because the present paper seeks to establish the ground rules on which a better understanding of speech analysis can be accomplished, much time is devoted to specifying and defining the various operations that must be taken into account.

1636

Michigan U. [Speech Research Lab.] Ann Arbor.

THE PERCEPTION OF STOPS AFTER S, by J. A. Reeds and W. S.-Y. Wang. [1959] [4]p. (AFOSR-TN-60-1205) (AF 49(638)492) Unclassified

Presented at meeting of the Michigan Linguistic Soc., Ann Arbor, Nov. 7, 1959.

Also published in Phonetica, v. 6: 78-81, 1961.

A new approach to the description of stop consonants is presented. In the three sets of words (1) by, die, guy, (2) pie, tie, chi, and (3) spy, sty, sky, it is pointed out that the set (1) stops are frequently unvoiced, whereas the set (2) stops are very rarely unaspirated. From such observations, it may be inferred that (a) aspiration is the primary feature distinguishing the stops of sets (1) and (2) and, (b) the stops of set (3) are phonetically more similar to those of set (1). Twelve listeners heard 30 test items, providing a total of 360 test response tokens. Of these 360, 353 words were judged to begin with b, d, g. Of the seven exceptions, none were so identified by more than one subject. Of the twelve subjects, seven consistently identified all 30 items as beginning with a set (1) stop consonant. The above results support the inference that the stops of set (3) are phonetically more similar to those of set (1) in terms of perceptual judgements.

1637

Michigan U. [Speech Research Lab.] Ann Arbor.

AUTOMATIC SPEECH RECOGNITION PROCEDURES, by G. E. Peterson. [1960] [20]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1236) (AF 49(638)492) Unclassified

Also published in Language and Speech, v. 4: 200-219, Oct.-Dec. 1961.

This paper is concerned with the transformation of the varying acoustical parameters of speech into a discrete code to form the printed output of an automatic speech recognizer. The development of general automatic speech recognition procedures requires a definition of the linguistic code to be transcribed, and a statement of the dialectal and other conditions under which the recognition is to be achieved. Essential procedures in automatic speech recognition include: the analysis of the input speech wave into a series of basic acoustical parameters in frequency; the representation of the normalized parameters by a set of phoneme and prosodeme candidates by reference to stored linguistic information; and the print-out into words separated by spaces and grouped by means of a set of punctuation marks. The possibility is

considered of employing values of conventional spelling and punctuation in the automatic representation of spoken American English. (Contractor's abstract)

1638

Michigan U. [Speech Research Lab.] Ann Arbor.

FREQUENCY STUDIES OF ENGLISH CONSONANTS, by W. S.-Y. Wang and J. Crawford. [1960] [9]p. incl. tables. (AFOSR-3282) (AF 49(638)492) Unclassified

Also published in Language and Speech, v. 3: 131-139, July-Sept. 1960.

In this study an explanation was sought for the disagreement among the various frequency counts which have been made of English consonants. The data for a set of ten different frequency counts were converted to IPA symbols and compared by means of the coefficient of linear correlation. It was found that the relative frequency of consonants in English is not seriously affected by the style of literary content or by the dialect of the sample and that a relatively small sample yields typical values. Differences in the general type of corpus (dictionary or running text) and in transcription, however, cause significant discrepancies among the various studies. It is concluded that higher order frequency data are probably more relevant to mechanical speech recognition than the first order data considered in this paper. (Contractor's abstract)

1639

Michigan U. [Willow Run Labs.] Ann Arbor.

MASER ACTION IN RUBY, by G. Makhov, C. Kikuchi and others. June 1958, 5p. incl. illus. (Rept. no. 2616-1-T) (AFOSR-TN-58-288) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-68 and Signal Corps under DA 36-039-sc-52654) AD 154192; PB 135368 Unclassified

Also published in Phys. Rev., v. 109: 1399-1400, Feb. 15, 1958.

Also published in Proc. Internat'l. Conf. on Solid State Physics in Electronics and Telecommunications, Brussels (Belgium) (June 2-7, 1958), New York, Academic Press, v. 4 (Part 2): 571-581, 1960. (Title varies)

For abstract see MIC.20:001, Vol. II.

1640

Michigan U. [Willow Run Labs.] Ann Arbor.

SPIN RESONANCE PROPERTIES OF SAPPHIRES, CERTAIN $A_{II}B_{VI}$ COMPOUNDS, AND CALCITE, by C. Kikuchi. Final rept. Oct. 1960, 62p. incl. diagrs. tables, refs. (Rept. no. 2616-17-F) (AFOSR-TR-60-131) (AF 49(638)68) AD 245582; PB 152836 Unclassified

This report summarizes the electron-spin resonance properties of sapphires with various iron group impurities, of certain A(II)B(VI) compounds, and of calcite. A block diagram of a molecular electronic material, such as pink ruby, is given to indicate possible directions for future investigations. (Contractor's abstract)

1641

Michigan U. Willow Run Labs., Ann Arbor.

ELECTRON NUCLEAR DOUBLE RESONANCE EXPERIMENTS WITH RUBY, by R. W. Terhune, J. Lambe and others. [1960] [3]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)68] and Signal Corps) Unclassified

Published in Phys. Rev. Ltrs., v. 4: 234-236, Mar. 1, 1960.

The observance of an apparent inverse in ruby (Al_2O_3:0.05% Cr^{+++}) of the polarization of nuclear spins throughout a crystal by saturation of an electron spin resonance of paramagnetic ions present as impurities is reported. When the induced nuclear polarization is partially removed by saturating an aluminum nuclear spin resonance transition, a large decrease in the power absorbed by the electron spin resonance of the Cr^{+++} ions is observed. The effect associated with inducing transitions between the hyperfine levels of the chromium-53 ions is also discussed. The spectrum obtained was achieved by scanning the frequency of a low-power rf oscillator connected to a single turn of wire around the ruby sample. The strong effect of nuclear polarization on the electron spin resonance can easily be observed in ruby without applying rf. The same decay time is observed for the transient following removal of rf power sufficient to saturate 1 of the aluminum nuclear transitions. The effects of nuclear polarization upon the electron spin resonance signal were observed when microwave power levels of the order of or greater than that needed to saturate the electron spin transition were used. The slow relaxation after the removal of rf power would seem to indicate that the host nuclei play an important role in either the inducted transitions probabilities or relaxation mechanisms between electron spin states.

1642

Michigan U. Willow Run Labs., Ann Arbor.

HYPERFINE STRUCTURE OF THE $(Cr^{53})^{+++}$ ION IN RUBY BY DOUBLE RESONANCE (Abstract), by R. W. Terhune, C. Kikuchi and others. [1960] [1]p. [AF 49-(638)68] Unclassified

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 157, Mar. 21, 1960.

The hyperfine spectrum of the trivalent Cr^{53} ions was obtained by observing the change in the electron spin resonance absorption under saturation conditions as the frequency of an rf oscillator connected to a coil around the ruby was scanned. Four triplets were observed centered near 25 and 75 mc with the magnetic field along the crystal c axis. Preliminary analysis indicates that A = 48.5 mc/sec in good agreement with the mc/sec value of Manenkov and Prokhorov. The details of the spectra at 0° and 90° will be presented and compared to theory.

1643

Michigan U. [Willow Run Labs.] Ann Arbor.

SPIN RESONANCE OF Mn^{++} IN CdTe (Abstract), by J. Lambe and C. Kikuchi. [1960] [1]p. [AF 49(638)68] Unclassified

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 158, Mar. 21, 1960.

Following the suggestion of Dorain, single crystals of CdTe containing 0.01% Mn^{++} were investigated in X band ESR spectrometer at 300°, 78°, and 4.2°K. At room temperature, only the 6 broad Mn-55 hfs lines are observed. At 78°K, the lines narrow, the fine structure components are resolved and at 4.2°K, the principal hfs lines split into a number of superhyperfine structure components due to Cd nuclei. The cubic zero field splitting, 3a for CdTe is 0.0084 cm^{-1}, compared to 0.00233 cm^{-1} for ZnS, despite the fact that the anion-cation distances in CdTe and ZnS are 2.78 and 2.36A, respectively. The g value shift is positive. The superhyperfine component spacing is 1.4 gauss, equal to that in CdS. The broadening of the lines at 300°K in CdTe is due to spin lattice interaction indicating a T_1 of about 10^{-8} sec, which is much shorter than is observed in CdS and ZnS. In CdS, broadening effects are observed only when a fairly high number of conduction electrons are present. This effect is then due to an interaction between conduction electrons and Mn^{++}.

1644

Michigan U. [Willow Run Labs.] Ann Arbor.

PARAMAGNETIC RESONANCE OF CdTe:Mn AND CdS:Mn, by J. Lambe and C. Kikuchi. [1960] [5]p. incl. diagrs. tables, refs. (AF 49(638)68) Unclassified

Published in Phys. Rev., v. 119: 1256-1260, Aug. 15, 1960.

Paramagnetic resonance absorption experiments have been carried out on CdTe and CdS crystals containing manganese. In CdTe, the lines are found to be very broad at 300°K. At 4.2°K lines narrow sufficiently to measure parameters with the result g = 2.010, A = 0.0055 cm^{-1}, and 3a = 0.0084 cm^{-1}, where 3a is the zero-field splitting. The superhyperfine splitting is the same as for CdS with components spaced at 1.4 gauss giving Acd = 2.6 x 10^{-4} cm^{-1}. In CdS an interaction with conduction electrons is found which can broaden lines at 300°K. At low temperatures an anomalous spectrum is found in CdS with D = 0.0295 cm^{-1}. (Contractor's abstract)

1645

Michigan U. [Willow Run Labs.] Ann Arbor.

PARAMAGNETIC RESONANCE ABSORPTION OF IONS WITH SPIN 5/2: Mn^{++} IN CALCITE, by C. Kikuchi and L. M. Matarrese. [1960] [6]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)68] and [Signal Corps under DA 36-039-sc-78801]) Unclassified

Published in Jour. Chem. Phys., v. 33: 601-606, Aug. 1960.

The theory of the paramagnetic resonance absorption of ions with S = 5/2 in crystalline fields of trigonal symmetry is presented. The case of manganous ions in calcite ($CaCO_3$) is taken as an example. It is shown that the splitting of the fine-structure satellites into doublets first reported by Hurd, Sachs, and Hershberger (Phys. Rev., v. 93: 373-380, Feb. 1, 1954) can be accounted for by assuming that the manganous ions can occupy the 2 nonequivalent Ca^{++} sites at random. The maximum splitting was measured at X band and K band and found to be 19.3 ± 0.5 gauss. The value computed from the theory, assuming an ionic model, is 23.8 gauss. In addition, 5 pairs of weak lines were found, each pair occurring midway between adjacent hyperfine groups. The origin of these lines is uncertain. The applicability of the present theory to Al_2O_3:Fe, in zero-field maser material, and to the photosensitive Fe^{+++} center in CdS is pointed out. (Contractor's abstract)

1646

Michigan U. Willow Run Labs., Ann Arbor.

OPTICAL EFFECTS ON F-CENTER SPIN RESONANCE AT LOW TEMPERATURES, by J. Lambe and J. Baker. [1960] [7]p. incl. diagrs. (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)68] and Signal Corps) Unclassified

Published in Quantum Electronics, A Symposium, Highview, N. Y. (Sept. 14-16, 1959), New York, Columbia U. Press, 1960, p. 93-99.

Measurements made on a system consisting of F-centers in KCl are discussed. An effect is observed on the F-center spin resonance signal by altering the spin temperature of theF-center by irradiation with F-band light. This system, containing about 10^{16} F-centers, is absorbing 1 mw of green light, i.e. about 2×10^{15} quanta/sec. It is calculated that this model must have a rate of spin flipping by light per center of $\frac{2 \times 10^{15} \text{ photons/sec}}{10^{16} \text{ centers}} \times 1/2$. The change in the number of spins, $\Delta n = 1/4\ \Delta n_0$. Possible experiments that would help contribute to information about local heating around the F-center are described.

1647

Midwest Research Inst., Kansas City, Mo.

[SOLUTION TO PROBLEM 60-4] VORTICITY INTERACTION BY SIN-I-CHENG, by Y. L. Luke. [1960] 4p. [AF 49(638)66] Unclassified

A solution is presented for the problem published in SIAM Review, v. 2: 151, Apr. 1960. The problem as seen by this author may be stated: find constants α and L such that (1) $[D^3 + x^2D^2 - xD + 1]\ F(x) = \alpha$, $D = d/dx$, (2) $F(0) = F'(0) = 0$, $F''(0) = 1$, $\lim_{x \to \infty} F'(x) = L$. The value of α is determined as - 0.53146 and $L = 0.88152$.

1648

Midwest Research Inst., Kansas City, Mo.

SURFACE PHENOMENA AND FRICTION, by T. B. Daniel. [1960] [12]p. incl. illus. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)389]; Office of Ordnance Research, and Wright Air Development Center) Unclassified

Published in Surface Effects and Spacecraft Materials First Symposium, Palo Alto, Calif. (May 12-13, 1959), New York, Wiley and Sons, 1960, p. 307-318.

Theories are discussed which attempt to explain friction in terms of microphysical phenomena occurring in the interface between sliding objects. Experiments on friction are reviewed and an attempt is made to interpret the data on the basis of the more widely accepted theories of friction. Friction studies at the Midwest Research Inst. are also reviewed with particular emphasis on experiments with graphite and MoS_2 systems. A study being made of the mechanism of friction using graphite whiskers is discussed, as is some other work currently in progress.

1649

Milan U. (Italy).

REACTION OF POTASSIUM TETRAIODO DICARBONYLIRIDIATE (III) WITH TRIPHENYLPHOSPHINE AND ANALOGOUS LIGANDS, by M. Angoletta. May 1, 1960, 10p. (Technical scientific note no. 3) (AFOSR-TN-60-460) (AF 61(052)83) AD 244413 Unclassified

Also published in Gazzetta Chim. Ital., v. 90: 1021-1027, 1960.

$KIr(CO)_2I_4$ with triphenylphosphite [$P(OR)_3$], triphenylphosphine [PR_3], triphenylarsine [AsR_3], p-toluidine (T), and α,σ-dipyridyl (Dip) gives the following compounds: $Ir[P(OR)_3]_2I_3$; $Ir(CO)_2(PR_3)_2I$ and $Ir(CO)(PR_3)_2I_2$; $Ir(CO)_2(AsR_3)I_3$ and $Ir(CO)(AsR_3)_2I_3$; $Ir(CO)_2T_2I_2$ and $Ir(CO)_2DipI_2$, respectively. The different oxidation numbers of iridium in these compounds are tentatively related to the effective electric charge of the metal. (Contractor's abstract)

1650

Milan U. (Italy).

NEW RHENIUM COORDINATION COMPOUNDS WITH LOW OXIDATION STATES, by L. Malatesta. Sept. 20, 1960, 17p. (Technical scientific note no. 4) (AFOSR-TN-60-1077) (AF 61(052)83) AD 252354; PB 155141 Unclassified

The preparation and properties of a number of new complexes of rhenium (I), (II) and (III) with π bonding ligands are described. Of rhenium (I), the compounds $Re(PR_3)_2(RNC)(CO)X$ and $Re(PR_3)_2(RNC)_2(CO)X$, ($R = C_6H_5$, X = Cl, Br) were prepared from $Re(PR_3)_2(CO)_2X$ with isocyanides, while the analogous $Re(PR_3)_2(CO)_2X$ (X = Cl, Br) was obtained by the direct carbonylation of $Re(PR_3)_2X_2$ at 200 atm and 50-60°C. The divalent salts $[Re(PR_3)_2(RNC)I]X$, ($X = I^-, I_3^-, ClO_4^-, BR_4^-$), were prepared from $Re(PR_3)_2I_2$ and isocyanides. Finally, the following compounds of rhenium (III) were prepared:

$ReX_3(RNC)$ (X = Cl, I) from ReX_3 and RNC, and $ReI_3[P(OR)_3]_3$ from K_2ReI_6 and triarylphosphites. All these compounds are well crystallized and stable substances. (Contractor's abstract)

1651

Milan U. (Italy).

SUBSTITUTION REACTIONS OF POTASSIUM PENTAIODOCARBONYLIRIDIATE (III) WITH AMMONIA AND ALIPHATIC AMMINES, by L. Malatesta and L. Naldini. Sept. 20, 1960, 9p. (Technical scientific note no. 5) (AFOSR-TN-60-1078) (AF 61(052)83) AD 252355; PB 155142 Unclassified

$K_2[Ir(CO)I_5]$ reacts in the cold with ammonia and primary aliphatic ammines, in the molar ratio 1 : 1, to give complex anions of the type $[Ir(CO)LI_4]$, (L = NH_3; $C_2H_5NH_2$; iso, $C_3H_7NH_2$), which were isolated as tetraphenilarsonium salts. With an excess of the ligand, $K_2[Ir(CO)I_5]$ gives in the cold the non-ionic trivalent compounds of the type $Ir(CO)L_2I_3$, while on warming the divalent derivatives $[Ir(CO)L_3I_2]$ are formed. (Contractor's abstract)

1652

Milan U. (Italy).

ELECTROCHEMICAL BEHAVIOUR OF OXYGEN AND HYDROGEN PEROXIDE ON SILVER ELECTRODES, by G. Bianchi, G. Caprioglio and others. May 1960 [40]p. incl. diagrs. tables, refs. (Technical scientific note no. 1) (AFOSR-TN-60-299) (AF 61(052)260) AD 242313; PB 150336 Unclassified

Also published in Electrochim. Acta, v. 4: 232-241, 1961.

The electrochemical behavior of oxygen and hydrogen peroxide on silver electrodes was studied by means of polarization curves. In acid and neutral solutions the process Ag = Ag+ interferes with those of the system $H_2O - H_2O_2 - O_2$. The reduction of O_2 and that of H_2O_2 occur in the same way at 0.15 v. The tension is independent from the pH. In alkaline solutions the reduction of O_2 occurs at 0.2 v and the oxide film covering the electrode does not interfere. The reduction of H_2O_2 occurs through its decomposition in H_2O and O_2 and the successive reduction of oxygen according to the process $O_2 + H_2O + 2e \rightarrow HO_2^- + OH^-$. The anodic formation of silver oxides is shown, but it does not interfere with the oxidation of H_2O_2 that occurs at a lower tension (0.18 v). (Contractor's abstract)

1653

Milan U. (Italy).

ELECTROCHEMICAL BEHAVIOUR OF OXYGEN AND HYDROGEN PEROXIDE ON TITANIUM ELECTRODES, by G. Bianchi, G. Caprioglio and others. Aug. 30, 1960 [29]p. incl. diagrs. tables, refs. (Technical scientific note no. 2) (AFOSR-TN-60-859) (AF 61(052)260) AD 252353; PB 155140 Unclassified

The electrochemical behavior of O_2 and H_2O_2 on Ti electrode was studied by means of polarization curves. Ti is an efficient electrodic material for the cathodic reduction of O_2 and H_2O_2. The tension at which the cathodic reduction of O_2 occurs is almost independent from the pH. The behavior of Ti as regards the electrochemical processes of O_2 and H_2O_2 is comparable to that of other metals like Ag and Au, in acid and neutral solutions. In alkaline solution the reversible reaction $O_2 \rightarrow H_2O_2$ occurs at tension about + 100/+200 mv on many metals (Pt, Ag, Au, graphite). On the contrary, on the Ti the reaction occurs at a less noble tension (- 300 mv). (Contractor's abstract)

1654

Milan U. (Italy).

ELECTROCHEMICAL BEHAVIOUR OF OXYGEN AND HYDROGEN PEROXIDE ON MAGNETITE ELECTRODES, by G. Bianchi, G. Caprioglio and others. Oct. 1960 [31]p. incl. illus. diagrs. tables, refs. (Technical scientific note no. 3) (AFOSR-TN-60-1209) (AF 61(052)260) AD 264717 Unclassified

Also published in Wertstoffe Korrosion, v. 13: 413-419, 1962.

Also published in Dechema-Monographien, v. 45: 299-318, 1962.

The electrochemical behavior of oxygen and hydrogen peroxide on magnetite electrodes was studied by means of polarization curves, tension build-up and tension decay curves. In alkaline solutions the oxygen is reduced at a tension near to that corresponding to the process $O_2 + 2H_2O + 2e = H_2O_2 + 2OH^-$. Also the hydrogen peroxide in concentrated solutions (10^{-2}M) is reduced at the same tension: the electrochemical process probably concerns the oxygen arising from the H_2O_2 decomposition. Anodic and cathodic processes for H_2O_2 are symmetric. In neutral solutions the processes concerning oxygen and hydrogen peroxide occur with the intervention of the redox systems of the iron compounds. The surface of the electrode is modified during a cathodic or anodic polarization. The surface modifications were evidenced by means of electron diffraction. (Contractor's abstract)

1655

Milan U. (Italy).

ELECTROCHEMICAL BEHAVIOUR OF OXYGEN AND HYDROGEN PEROXIDE ON ALUMINUM, TANTALUM AND ZIRCONIUM ELECTRODES, by G. Bianchi, G. Caprioglio and others. Dec. 1960 [21]p. incl. diagrs. tables, refs. (Technical scientific note no. 4) (AFOSR-TN-60-1468) (AF 61(052)260) AD 264718
Unclassified

Also published in Chim. e Indus. (Milan), v. 43: 867-871, Aug. 1961.

The cathodic reduction of O_2 and H_2O_2 on Al, Ta, and Zr was studied by means of a polarization cell and an electronic potentiostat. Al, Ta and Zr, although covered by an oxide layer, acted as cathode for the processes of O_2 and H_2O_2 reduction. Overvoltage valves and the polarization curves are listed. The results obtained on these 3 metals are compared with those previously obtained on Ti. Overvoltages for cathodic reduction of O_2 decrease in the following order: Zr, Ta, Ti for acid; Al, Ta, Zr, Ti for neutral; and Zr, Ti, Ta for alkaline solutions. These results indicate that the dangers of galvanic corrosion with Zr and Ta are less than those for Ti. (Contractor's abstract)

1656

Milan U. Inst. of General Pathology (Italy).

CELLULAR DAMAGE PRODUCED BY HYPOXIA, by E. Ciaranfi. Final rept. Oct. 30, 1959 [8]p. (AFOSR-TR-60-42) (AF 61(514)1026) AD 234214; PB 146622
Unclassified

The consequences of hypoxia have been studied on rat liver cells, by the aid of electron microscopy and by different biochemical techniques. The most evident alteration as revealed by the former technique is the presence of smooth, round vesicles, varying in size and electron density in the liver. Biochemical studies on protein synthesis in vacuolated liver cells have shown that the incorporation of glycine, leucine, and phenylalanine was significantly reduced in hypoxic liver sections. The synthesis of p-aminohippuric acid, was also impaired and it was concluded that synthetic activity must be impaired in these cells. In investigations of the same nature in relation to the brain it was found that the brain is less affected than the liver by the same hypoxia conditions. The results found in hypoxic cells were also compared with livers affected with other degenerative changes. Coenzyme A was found markedly reduced in fatty livers produced with either CCl_4 or phosphorus injection.

1657

Milan U. Inst. of General Pathology (Italy).

ELECTRON MICROSCOPY OBSERVATIONS ON LIVER CELLS FROM HYPOXIC RATS, by M. Bassi, A. Bernelli-Zazzera, and E. Cassi. [1960] [5]p. [AF 61-(514)1026]
Unclassified

Published in Jour. Pathol. and Bacteriol., v. 79: 179-183, 1960.

Hypoxia was induced in the rats by keeping them for 2 hr in an atmosphere of 3% oxygen and 97% nitrogen. The main feature of hypoxic liver cells, as revealed by electron microscopy, is the presence in the cytoplasm of smooth round vesicles, varying in size and electron-density. These vesicles do not seem to be related to mitochondria, which have generally a normal appearance, a conclusion that accords with the results of biochemical assays carried out on homogenates of hypoxic livers. Catalase, uricase and succinic dehydrogenase activities, which are bound to cytoplasmic particles of different size, are not altered in homogenates of vacuolated liver cells. The endoplasmic reticulum and nucleus show no alterations. The vesicles seen in hypoxic liver cells by electron microscopy are not visible by phase contrast microscopy. They are much smaller than the vacuoles observed in conventional fixed and stained sections. It seems reasonable, therefore, to conclude that the cellular lesions induced in rat liver cells by hypoxia are less severe in degree than the appearance of routine fixed and stained sections may suggest.

1658

Milan U. Lab. of Physiology (Italy).

WIRELESS TELESTIMULATION OF THE CAT'S MOTOR CORTEX WITH CONSTANT STIMULI, by S. Bonazzola and T. Gualtierotti. [1959] [2]p. incl. diagr. (AFOSR-TN-60-1294) (AF 61(052)23) AD 246196
Unclassified

Presented at meeting of the Physiol. Soc., Charing Cross Hospital School, London (Gt. Brit.), Dec. 11-12, 1959.

Also published in Jour. Physiol. (London), v. 150: 1P-2P, Jan. 1960.

Wireless stimulation of the cat's cortical motor centers at a distance of up to 50 yd was achieved by using a receiver-stimulator developed in order (a) to be small enough to be chronically implanted under the animal's skin, and (b) to apply stimuli of a constant amplitude and duration whatever the position and the movements of the animal. (Contractor's abstract)

1659

Milan U. Lab. of Physiology (Italy).

[THE FREQUENCY OF DISCHARGE OF THE SPINAL MOTOR NEURONS IN MAN'S UPPER AND LOWER LIMB RELATIVE TO THE TENSION DEVELOPED IN THE MUSCLE] La frequenza di scarica dei motoneuroni spinali nell'arto superiore e inferiore dell'uomo in relazione con la tensione sviluppata dal muscolo, by T. Gualtierotti and F. Bracchi. [1959] [4]p. incl. diagrs. (AFOSR-TN-60-1295) (AF 61(052)23) Unclassified

Presented at Eleventh Cong. Nazionale Societa Ital. di Fisiologia, Salsomaggiore (Italy), Oct. 8-10, 1959.

Also published in Boll. Soc. Ital. Biol. Sper., v. 35: 2071-2074, 1959.

The investigations made study the relationship between the discharge of the single muscle fiber (and consequently of the single motor neuron) and the tension developed by the muscle in the limits of small variations of the tension. The characteristics of the discharge frequencies of the several muscles of the upper and lower limb are observed.

1660

Milan U. Lab. of Physiology (Italy).

[DISTRIBUTION OF THE DISCHARGE FREQUENCY OF SINGLE FIBERS OF MAN'S MUSCULAR SYSTEM DURING MAXIMUM ISOMETRIC CONTRACTION] Distribuzione della frequenza di scarica della singolo fibra del muscolare dell'uomo durante contrazioni isometriche massimali, by F. Bracchi, M. Cattorini, and T. Gualtierotti. [1960] [5]p. incl. diagrs. table. (AFOSR-1242) (AF 61(052)23) Unclassified

Also published in Atti Accad. Naz. Lincei, Rend. Classe Sci. Fis. Mat. e Nat., v. 29: 604-608, Dec. 1960.

The studies described are carried out to determine the distribution of discharge frequencies of the single muscular fiber, and consequently of the single spinal motor neuron in the different body areas of an individual. The technique of Gualtierotti and Bracchi is used to determine the discharge frequency of at least four fibers for a period of 1/2 – 1 min at the max voluntary isometric tension. Results are shown in a table for the 11 muscles tested. Relative strengths of the various muscle fibers are compared.

1661

Milan U. Lab. of Physiology (Italy).

[LESIONS OF THE LABYRINTH OF FROG SUBJECTED TO CENTRIFUGATION] Le lesioni del labirinto nelle rane sottoposte a centrifugazione, by C. Testa and U. Bordoni. [1960] [4]p. incl. diagr. (AFOSR-1243) (AF 61(052)23) Unclassified

Also published in Atti Accad. Naz. Lincei, Rend. Classe Sci. Fis. Mat. e Nat., v. 29: 600-603, Dec. 1960.

The investigation described treats the vestibular disturbances in frogs subjected to centrifugation. The hypothesis of an unknown mechanism responsible for orientation and equilibrium unrelated to the traditional systems of the vestibule, sight, cutaneous and muscular receptors is studied by examining frogs whose labyrinth has been removed either monolaterally or bilaterally. Results are given in discussion and graphs are presented showing the posture, jumping and swimming activity.

1662

[Minneapolis-Honeywell Regulator Co.] Hopkins, Minn.

ELECTRICAL PROPERTIES OF CLEAVED GERMANIUM SURFACES, by D. R. Palmer, S. R. Morrison, and C. E. Dauenbaugh. [1960] [6]p. incl. diagrs. refs. [AF 49-(638)597] Unclassified

Published in Jour. Phys. and Chem. Solids, v. 14: 27-32, July 1960.

The effects of oxygen on the electrical properties of a cleaved germanium surface have been studied by measuring the field effect, conductance, and photoconductance. Upon cleavage, the surface is more p-type than the bulk and remains unchanged in a vacuum of about 10^{-9} mm Hg or less. When initially exposed to oxygen, the conductance tends toward a more p-type surface; then the surface changes towards n-type continuously at a constant oxygen pressure. When the system is evacuated, the surface reversibly becomes more p-type, indicating that oxygen tends to make the surface more n-type. In addition, the slow relaxation of the field effect in oxygen almost disappears in vacuum. The surface eventually becomes n-type in oxygen at 15 mm Hg for all samples measured, an effect which has not apparently been observed on surfaces cleaned by argon bombardment. The results are interpreted in terms of acceptor states at the surface and donor states which depend on sorbed oxygen and produce a slow relaxation of the field effect. (Contractor's abstract)

1663

Minneapolis-Honeywell Regulator Co., Hopkins, Minn.

THE OPTICAL AND ELECTRICAL PROPERTIES OF SINGLE CRYSTAL TELLURIUM. Quarterly rept. no. 1. Aug. 31, 1960, 36p. incl. diagrs. tables, refs. (AFOSR-284) (AF 49(638)908) AD 253396; PB 155483 Unclassified

This is the first in a series of quarterly reports

describing the basic research on the semiconductor, Te. The obtained measurements on this high-quality material disagree in some cases with previously reported work on Bridgeman-type crystals and are described in four papers. For individual abstracts, see item nos. 1664, 1667, 1669, and 1670, Vol. IV.

1664

[Minneapolis-Honeywell Regulator Co.] Hopkins, Minn.

RECOMBINATION PROCESSES IN TELLURIUM, by J. S. Blakemore. [1960] [3]p. incl. diagrs. (AFOSR-3620) (Also bound with its AFOSR-284; AD 253396) (AF 49-(638)908) Unclassified

Published in Proc. Internat'l. Conf. on Semiconductor Physics, Prague (Czechoslovakia) (Aug. 29-Sept. 2, 1960), Prague, Publishing House of the Czechoslovak Academy of Sciences, 1961, p. 981-983.

Carrier lifetime in Te crystals depends markedly on the presence of recombination centers and lattice imperfections. In extensively purified monocrystals the lifetime behavior above 300°K suggests control by band-to-band transitions. Calculations have been made of the radiative and Auger recombination rates, and experimental data between 300-420°K fit the sum of these two rates. (Contractor's abstract)

1665

[Minneapolis-Honeywell Regulator Co.] Hopkins, Minn.

ENANTIOMORPHOUS CHARACTER OF ETCH PITS IN TELLURIUM, by J. S. Blakemore and K. C. Nomura. [1961] [2]p. incl. illus. (AFOSR-3621) [AF 49(638)908] Unclassified

Also published in Jour. Appl. Phys., v. 32: 745-746, Apr. 1961.

The possibility that crystals with right-handed spirals (space group D_3^4) and with left-handed spirals (space group D_3^6) should occur in nature is discussed. The enantiomorphous development of etch pits in levo- and dextro-rotatory Te crystals are illustrated. It is confirmed that the 2 shapes are mirror images of each other, and cannot be made congruent by rotation. However, when a crystal is cleaved, etch pits developed on the 2 newly created faces point in opposite directions but can be made congruent by a 180° rotation.

1666

[Minneapolis-Honeywell Regulator Co.] Hopkins, Minn.

SOME EFFECTS OCCURRING IN DISLOCATED TELLURIUM, by J. S. Blakemore, J. W. Schultz, and K. C. Nomura. [1960] [6]p. incl. illus. diagrs. refs. (AFOSR-3622) [AF 49(638)908] Unclassified

Published in Jour. Appl. Phys., v. 31: 2226-2231, Dec. 1960.

Dislocation densities as small as 1000 cm^{-2} are sometimes found in carefully produced single crystals of Te, but since the material is very soft a quite mild stress can introduce 10^6 dislocations/sq cm or more. Dislocation etch pits of sharply geometric shape can be developed on the cleavage $(10\bar{1}0)$ planes by the slow attack of H_2SO_4; their planar surfaces correspond to $(1\bar{1}00)$, $(10\bar{1}3)$, $(01\bar{1}1)$, and $(0\bar{1}1\bar{1})$ faces. Effects are noted on faces exposed by cleavage at 77°K which suggest that even at this temperature the material can suffer localized plastic damage, for brief etching of such faces produces small flat-bottomed pits; these may be interpreted by supposing that the mild stress of cleavage at 77°K generates shallow dislocation loops. The flat-bottomed pits disappear when a surface layer ≥ 25μ is etched away. A marked increase in electron-hole recombination rate is noted in plastically deformed crystals. If the additional recombination occurs through the dislocations themselves, then each has a capture radius of some 4×10^{-8} cm at 300°K. Dislocated crystals also show more prominent trapping effects at low temperatures than structurally pure samples, and contain additional readily ionizable acceptor sites; these may be derived from the dislocations themselves or from other defects created or activated by plastic flow. (Contractor's abstract)

1667

[Minneapolis-Honeywell Regulator Co.] Hopkins, Minn.

THE GALVANOMAGNETIC COEFFICIENTS OF TELLURIUM AT 4.2°K, by A. Nussbaum and D. Long. [1960] [3]p. incl. diagr. tables. (AFOSR-3623) (Also bound with its AFOSR-284; AD 253396) (AF 49(638)908) Unclassified

Published in Proc. Internat'l. Conf. on Semiconductor Physics, Prague (Czechoslovakia) (Aug. 29-Sept. 2, 1960), Prague, Publishing House of the Czechoslovak Academy of Sciences, 1961, p. 990-992.

The 12 elements of the galvanomagnetic tensor which are normally nonvanishing in a trigonal crystal were measured on pure, single-crystal Te at 4.2°K. The data obtained for a series of individual samples support the idea of an ellipsoidal valence band, but when results for several samples of different orientations from the same crystal are combined, the evidence for or against this interpretation is inconclusive. (Contractor's abstract)

1668

[Minneapolis-Honeywell Regulator Co.] Hopkins, Minn.

OPTICAL ACTIVITY IN TELLURIUM, by K. C. Nomura. [1960] [2]p. incl. diagrs. (AFOSR-5213) [AF 49(638)-908] AD 419511 Unclassified

Also published in Phys. Rev. Ltrs., v. 5: 500-501, Dec. 1, 1960.

Elementary tellurium, having a symmetry which classifies it as enantiomorphous, was examined for optical rotatory power. The effect was found to be large in both left- and right-handed single crystals, yielding a value for the difference in refractive indices of the ordinary and extraordinary rays in the direction of the optic axis of $\pm 1.58 \times 10^{-3}$ at 5 μ wavelength. Deviations from normal dispersion were observed for wave numbers greater than 0.20×10^{4} cm^{-1}, which is consistent with other measurements of refractive index.

1669

Minneapolis-Honeywell Regulator Co., Hopkins, Minn.

ENANTIOMORPHISM AND OPTICAL ACTIVITY IN TELLURIUM, by K. C. Nomura. Aug. 31, 1960 [7]p. incl. diagrs. (Bound with its AFOSR-284; AD 253396) (AF 49(638)908) Unclassified

The crystal structure of Te atoms arranged along parallel spiral chains at the vertices and center of a hexagon is described. The sense of the rotation of the spirals may be either left or right-handed corresponding to the space groups D_3^6 and D_3^4, respectively. Single crystals of both types were grown by the Czochralski method. The measurements were made by means of a Model 112, Perkin-Elmer, single beam double pass infrared spectrometer with NaCl optics. The measurement techniques are described. The optical activity in Te at room temperature is graphically shown. It is noted that the rotary power (θ/d) is linear for $10^4 \bar{\nu} < .20$ ($\lambda > 5$ microns). This spectral region is nearly free of dispersion. At shorter wavelengths, however, dispersion occurs and the rotary power begins to increase rapidly. Except for the sense of the optical rotation, the results for left- and right-handed crystals were the same.

1670

Minneapolis-Honeywell Regulator Co., Hopkins, Minn.

RESISTIVITY AND MOBILITY IN EXTRINSIC TELLURIUM, by D. Long and B. Kizilos. Aug. 31, 1960 [6]p. incl. diagrs. (Bound with its AFOSR-284; AD 253396) (AF 49(638)908) Unclassified

Experiments were carried out on samples taken from single crystals grown by the Czochralski method, separated from the crystals and shaped by methods involving cleaving at liquid N_2 temperature and cutting with a precision sandblaster to minimize crystal damage, and oriented such that the current-flow direction was parallel to the c-axis. The obtained results are discussed and described in the following graphs: (1) Resistivity and Hall coefficient vs $10^3/T$ for sample Te-9-14-60. (2) Hole mobility vs T for Te-9-14-60. (3) Resistivity vs T in Te samples. The results should be considered to be preliminary and tentative until more adequate control over the preparation of samples is developed.

1671

Minnesota U., Minneapolis.

A GENERAL CLASS OF LINEAR TRANSFORMATIONS OF WIENER INTEGRALS, by D. A. Woodward. Jan. 7, 1960 [31]p. (Technical note no. 12) (AFOSR-TN-60-36) (AF 18(603)30) AD 237352; PB 147168 Unclassified

Also published in Trans. Amer. Math. Soc., v. 100: 459-480, Sept. 1961.

A formula is obtained for the transformation of Wiener integrals under a general class of linear transformations of the Wiener space of continuous functions on [0,1] which vanish at zero. The transformation of Wiener space considered is $(t) = x(t) + \int_0^1 L(t,s)dx(s)$. The main result of the paper is Theorem A which is developed by the above transformation carrying the continuous function space C onto C in a one to one manner. Then if F(y) is a measurable functional such that either side of the following equation exists, both sides exist and are equal $\int_c^w F(y)d_w y = |P(\bar{M})| \int_c^w F(x(\cdot) + \int_0^1 L(\omega,s)dx(s))\exp[-\Psi(x)]\, d_w x$ where $\Psi(x) = \int_0^1 [\int_0^1 \bar{M}(t,s)dx(s)]^2 dt + 2\int_0^1 \int_0^1 M(t,s)dx(s)dx(t) + \int_0^1 J(t)d(x(t))^2$.

1672

Minnesota U., Minneapolis.

POLYNOMIALS DEFINED BY A DIFFERENCE SYSTEM, by G. Baxter. Oct. 15, 1959, 74p. (Technical note no. 11) (AFOSR-TN-60-93) (AF 18(603)30) AD 232430; PB 145761 Unclassified

Also published in Bull. Amer. Math. Soc., v. 66: 187-190, May 1960.

A study is made of the polynomials $u_n(t)$ and $v_n(t)$ which are defined by the difference system $\Delta u_n = \alpha_n e^{int} v_n$ $\Delta v_n = \beta_n e^{-int} u_n$, where α_n and β_n are presumed known. A relation between u_n and v_n and orthogonal polynomials as defined by Szegö is also considered. Application is made of the results to the problem of determining the distribution of max $(S_0,\ldots,S_n)$ and min $(S_0,\ldots,S_n)$ for the partial sums S_n of a sequence of independent, identically distributed random variables. (Contractor's abstract)

1673

Minnesota U., Minneapolis.

NONLINEAR VOLTERRA FUNCTIONAL EQUATIONS AND LINEAR PARABOLIC DIFFERENTIAL SYSTEMS, by J. Yeh. [1959] [25]p. (AFOSR-3358) (AF 18(603)30) Unclassified

Also published in Trans. Amer. Math. Soc., v. 95: 408-432, June 1960.

The existence of a certain duality between almost everywhere type existence problems for solutions of nonlinear Volterra functional equations and minimality problems of positive solutions for certain linear parabolic differential systems is developed and expanded in an attempt to prove various theorems resultantly. The functional equations obey the general formula for the following type: $y(t) = x(t) + \int_0^t F^2\{s,x(s), \int_0^s F^1[r,x(r)]dr\}ds$.

1674

Minnesota U., Minneapolis.

SINGLE-DOMAIN PARTICLES: NEW USES OF OLD THEOREMS, by W. F. Brown, Jr. Feb. 1960 [82]p. incl. diagrs. table, refs. (AFOSR-TN-60-61) (AF 18-(603)113) AD 232991; PB 145853 Unclassified

Also published in Amer. Jour. Phys., v. 28: 542-551, Sept. 1960.

Some applications are given of potential theory and classical dynamics to the theory of magnetization processes in hard magnetic materials. Many such materials owe their magnetic properties to the fact that they are composed of fine ferromagnetic particles separated by less magnetic regions. In very fine particles, the exchange forces responsible for the spontaneous magnetization keep it uniform in direction within any one particle; the magnetization curve is then determined by rotations of the particle magnetizations, controlled by the interplay of external magnetic energy and of internal energy, also largely magnetic. A first step in the theory is therefore the derivation of a general formula for the internal magnetic energy. Simplifications can then be made because of the uniformity of magnetization of each particle: in particular, it can be shown that a particle of arbitrary shape is equivalent to an ellipsoid. Calculation of static hysteresis loops requires consideration of stability conditions; analysis of magnetization reversals and of the behavior in microwave fields involves the dynamics of gyroscopic systems. (Contractor's abstract)

1675

Minnesota U., Minneapolis.

STUDY OF THE NATURAL AND INDUCED MAGNETIC SPECTRA OF SOME FERRITES, by A. H. Morrish. Final rept. July 1960 [44]p. incl. diagrs. tables, refs. (AFOSR-TR-60-90) (AF 18(603)113) AD 242662 Unclassified

The object of this research was to investigate the magnetic spectra, both natural and induced, of some ferrites, particularly as a function of particle size, and at various temperatures. The results in brief are discussed below under separate topics of the research. Natural spectra of some ferrites: The initial permeability of some magnetite and gamma ferric oxide powders has been determined in the 8-12 kmc range. No resonances were observed. Interaction effects have been studied. It appears that these have the effect of decreasing the spin-frequency. Ferramic A powders have also been studied. Ferrimagnetic resonance in magnetite spheres with either domain structure or with twinning: A theoretical analysis of the ferrimagnetic resonance spectra expected in a magnetite sphere with either domain structure or twinning is made. The results agree qualitatively with the experimental measurements reported earlier. Induced spectra of γ-Fe_2O_3 spheres: A technique to manufacture small spheres of Lucite-γ-Fe_2O_3 mixtures has been developed. It has been found that the magnetic resonance frequency is a function of particle shape, as expected from the earlier natural spectra measurements. Ferromagnetic resonance in thin permalloy films: The resonance data indicate that the magnetization M_s of a thin film decreases with thickness, especially below 200A. Double resonances in some films are believed to arise from an oxygen-rich layer and an oxygen-poor layer of permalloy. (Contractor's abstract)

1676

Minnesota U., Minneapolis.

MAGNETIC PROPERTIES OF THE LOW-TEMPERATURE FORM OF MAGNETITE, by D. B. Bonstrom, A. H. Morrish, and L. A. K. Watt. [1960] [2]p. incl. diagrs. table. (AFOSR-3665) (AF 49(638)803) Unclassified

Also published in Jour. Appl. Phys., Suppl., v. 32: 272S-273S, Mar. 1961.

Some of the magnetic properties of the orthorhombic form of magnetite (Fe_3O_4) have been studied from 2°K to the transition temperature (~119°K). Both ferromagnetic resonance measurements on single crystals and coercive force measurements on small particles have been made. The "twinning" of orthorhombic magnetite has been investigated. The crystalline anisotropy constants have been determined; they are of the order of 10^6 ergs/cm^3. The coercive force of single-domain and multidomain particles has been interpreted in terms of the crystalline anisotropy. (Contractor's abstract)

1677

Minnesota U. Dept. of Aeronautical Engineering, Minneapolis.

EFFECT OF CELL GEOMETRY ON THE SHEAR MODULUS AND ON DENSITY OF SANDWICH PANEL CORES, by C.-C. Chang and I. K. Ebcioglu. [1960] [6]p. incl. diagrs. table. (AFOSR-TN-60-428) (AF 18(603)112) Unclassified

Presented at Winter annual meeting of the Amer. Soc. of Mechanical Engineers, New York, Nov. 27-Dec. 2, 1960.

Also published in Jour. Basic Eng., v. 83: 513-518, Dec. 1961.

The simple analytic theory for the effect of cell geometry on both the shear modulus and the density of sandwich panel is presented. The core shear modulus in different directions is analyzed to include the effects of the angle α and the aspect ratio b/a of the cell. It is found that the minimum cell weight of the sandwich core depends both on the cell angle α and the cell aspect ratio b/a. The theory geometry chosen is so general that the regular hexagonal and square cells of commercial sandwich cores are special cases. (Contractor's abstract)

1678

Minnesota U. Dept. of Aeronautical Engineering, Minneapolis.

TRANSIENT AND PERIODIC RESPONSE OF A LOADED SANDWICH PANEL, by C.-C. Chang and B. T. Fang. [1960] [47]p. incl. diagrs. refs. (AFOSR-TN-60-1301) (AF 18(603)112) AD 257226 Unclassified

Presented at Twenty-eighth annual meeting of the Inst. Aeronaut. Sci., Aeroelasticity Session, New York, Jan. 25-27, 1960. (Title varies)

Also published in Jour. Aero/Space Sci., v. 28: 382-396, May 1961.

The flexural motion of a rectangular sandwich panel with an orthotropic viscoelastic core is investigated. Differential equations and boundary conditions are derived by taking into account the rotational inertia of the whole panel, and the shearing deformation and viscoelastic damping of the core. The dynamic response of a simply supported rectangular panel to a unit step function is first obtained, and then the general transient and steady-state response of the panel to an arbitrary input function is expressed in terms of the unit response by means of the convolution integral. It is shown that 3 families of modal shapes of vibration are possible for each nodal pattern of the panel. The frequencies and amplitudes of vibration of these 3 modes are discussed in detail for the case of an isotropic and elastic sandwich panel. The effects of viscoelastic core and edge compression are also discussed. Two simple physical parameters which represent the effects of shearing deformation and rotational inertia, respectively, are found very essential in the analysis. A number of limiting cases are discussed in detail. (Contractor's abstract)

1679

Minnesota U. Dept. of Aeronautical Engineering, Minneapolis.

THERMOELASTIC BEHAVIOR OF A SIMPLY SUPPORTED SANDWICH PANEL UNDER LARGE TEMPERATURE GRADIENT AND EDGE COMPRESSION, by C.-C. Chang and I. K. Ebcioglu. [1959] [13]p. incl. diagrs. refs. (AFOSR-1046) (AF 18(603)112) Unclassified

Presented at Twenty-seventh annual meeting of the Inst. Aeronaut. Sci., Thermal Stress Session, New York, Jan. 26-29, 1959.

Also published in Jour. Aero/Space Sci., v. 28: 480-492, June 1961.

The treatment is concerned with the thermal elastic behavior of a rectangular sandwich panel which is subjected to edge compression, transverse load, and high temperature difference between the 2 faces. The differential equations and boundary conditions are formulated from the principle of variational potential energy. The thermal effect on Hoff's boundary conditions is also formulated. For the case of the simply supported panel, an analytic theory is presented to solve for the displacements, the deflection and experimental verifications are shown. As a limiting case, an infinitely wide sandwich panel under cylindrical bending is also treated. For application, 17-7PH stainless steel sandwich panel with 1 face at 900°F and the other at 100°F is illustrated under both edge compression and transverse load. The maximum stresses on both faces are given as a function of edge compression. (Contractor's abstract)

1680

Minnesota U. Dept. of Electrical Engineering, Minneapolis.

INFLUENCE OF NEGATIVE IONS ON AMBIPOLAR DIFFUSION OF ELECTRONS, by H. J. Oskam and V. R. Mittlestadt. [1960] [2]p. incl. diagr. (AFOSR-TN-60-160) [AF 49(638)378] AD 238843 Unclassified

Also published in Jour. Appl. Phys., v. 31: 940-941, May 1960.

The ambipolar diffusion coefficient, estimated from measurements of frequency shift observed in microwave discharges in Ne + 0.1% A, increased with time. This increase is attributed to the presence of negative ion impurities released from walls.

1681

Minnesota U. Dept. of Electrical Engineering, Minneapolis.

THE MEASUREMENT OF CONDUCTIVITY AND PERMITTIVITY OF SEMICONDUCTOR SPHERES BY AN EXTENSION OF THE CAVITY PERTURBATION METHOD, by K. S. Champlin and R. R. Krongard. [1960] [7]p. incl. illus. diagrs. table, refs. (AFOSR-TN-60-1464) (AF 49(638)747) AD 456500 Unclassified

Also published in I.R.E. Trans. on Microwave Theory and Tech., v. MTT-9: 545-551, Nov. 1961.

A technique based on cavity perturbation theory is described with which the microwave conductivity and dielectric permittivity of a small sphere of completely arbitrary conductivity can be determined. These properties follow from the measured frequency shift and quality change occurring when the sample is inserted into a region of max electric field in a cavity resonator. The range of validity of the quasi-static internal field approximation is discussed, and curves are provided for extending the measuring technique beyond this range. The extended theory is valid for the entire conductivity range from zero to infinity. Measurements on the several samples of known conductivity and permittivity in which the approximation is not satisfied are seen to agree with the theory. For highly conductive materials, the present method is closely related to the eddy current loss measuring technique. The two methods are compared from the point of view of perturbation theory in order to determine their relative merits. Because the measuring technique employs a spherical sample, it may be applied profitably to materials with nonisotropic carrier mobilities and to semiconducting materials for which contact fabrication techniques are poorly known. (Contractor's abstract)

1682

Minnesota U. Dept. of Electrical Engineering, Minneapolis.

HALL FIELD RELAXATION IN SEMICONDUCTORS AT HIGH FREQUENCY, by K. S. Champlin. [1960] [2]p. incl. diagrs. (AFOSR-TN-60-1465) [AF 49(638)747] AD 252966 Unclassified

Also published in Jour. Appl. Phys., v. 31: 1770-1771, Oct. 1960.

A simple calculation of magneto-ionic theory demonstrates the frequency dependence of the complex Hall field relaxation phenomenon for samples with rectangular, cylindrical, and spherical geometry. Figures and graphs are given showing that in an open circuit Hall effect experiment, which uses one microwave field and one steady field, the magnitude of the observed microwave Hall field decreases when the frequency becomes of the order of the inverse dielectric relaxation time ($\sigma/K\epsilon_0$) of the material.

1683

Minnesota U. [Dept. of Mathematics] Minneapolis.

ON SIMILARITY INVARIANTS OF CERTAIN OPERATORS IN L_p, by G. K. Kalisch. [1960] [6]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)64] and National Science Foundation) Unclassified

Published in Pacific Jour. Math., v. 11: 247-252, 1961.

The result of a previous paper (Ann. Math., v. 66: 481-494, 1957) on Volterra operators is extended to the most general situation applicable. Operators T_F are considered where $F(x, y) = (y - x)^{m-1} aG(x, y)$ is a function defined on the triangle $0 \leq x \leq y \leq 1$, where m is a positive integer, a is complex number of absolute value 1, G is a complex valued function which is continuously differentiable and $G(x, x)$ is positive real. Three theorems are proved here. The first states that if c_1 and c_2 are complex numbers and r_1 and r_2 are real numbers such that $r_i \geq 1$, then $c_1 T_E^{r_1}$ is similar to $c_2 T_E^{r_2}$ if and only if $c_1 = c_2$ and $r_1 = r_2$. Theorem 2 lists the conditions, one of which $F(x, y) = (y - x)^{m-1} aG(x, y)$ must satisfy. The last theorem treated here states that the linear transformation $T_E + T_E^{1+a}$ where $0 < a < 1$ of $L_p[0,1]$ into itself is not similar to any linear transformation cT_E^r for complex c and real $r \geq 1$.

1664

Minnesota U. [Dept. of Mathematics] Minneapolis.

NOTE ON THE TENSOR PRODUCT OF BANACH ALGEBRAS, by B. R. Gelbaum. June 18, 1960, 4p. (AFOSR-TN-60-673) (AF 49(636)526) AD 239606 Unclassified

Also published in Proc. Amer. Math. Soc., v. 12: 750-757, Oct. 1961.

The relation between the maximal ideal space of a tensor product of Banach algebras and the Cartesian product of the maxima ideal spaces of the algebras is investigated from the standpoint of the kernel-hull topologies. (Contractor's abstract)

1665

Minnesota U. [Dept. of Mathematics] Minneapolis.

BANACH ALGEBRAS, by B. R. Gelbaum. [1960] [2]p. (AFOSR-TR-60-86) [AF 49(638)526] Unclassified

The progress made to date under this contract is briefly reviewed. The initial problem has been resolved and its solution is reported elsewhere.(item no. 1684, Vol. IV). The problem of semisimplicity, the results of which have not yet been published is concerned with whether there exists a (Hilbert-Schmidt) matrix $C = (c_{ij})$ satisfying the following requirements: (1) $|c_{ij}| \leq a_i a_j$, where $a_i > 0$, $\sum_{i=1}^{\infty} a_i^2 < \infty$; (2) $C^2 = 0$; and (3) $\sum_{i=1}^{\infty} c_{ij} = 1$. In connection with the matrices C, their membership in the trace class is excluded by (2) and (3). It is further shown that (1) does not imply membership in the trace class.

1666

Minnesota U. [Dept. of Mathematics] Minneapolis.

RELATIVE INTERPRETATIONS, by S. Orey. Mar. 2, 1960 [22]p. (AFOSR-TN-60-373) (AF 49(638)617) AD 236247; PB 147122 Unclassified

Also published in Zeitschr. fur Math. Logik und Grundlagen Math., v. 7: 146-153, 1961.

The existence of relative interpretations of an elementary theory B into an elementary theory A are studied. New results are proved connecting the existence of such interpretations and syntactical assertions about B provable in the number theory A. A by-product is an arithmetization of Godel's first undecidability theorem. The existence of relative interpretations which preserve also nonprovability is investigated. (Contractor's abstract)

1687

Minnesota U. [Dept. of Mathematics] Minneapolis.

SUMS ARISING IN THE THEORY OF MARKOV CHAINS, by S. Orey. [1960] [10]p. (AFOSR-TN-60-1067) (AF 49-(636)617) AD 243767; PB 152389 Unclassified

Also published in Proc. Amer. Math. Soc., v. 12: 847-856, Dec. 1961.

The relation $\lim_{N\to\infty} \frac{\sum_{n=0}^{N} p_{ij}^{(n)}}{\sum_{n=0}^{N} p_{kh}^{(n)}} = \frac{m_j}{m_h}$ is strengthened by showing that the partial sums $\sum_{n=0}^{N} [m_h p_{ij}^{(n)} - m_j p_{kh}^{(n)}]$, which exhibit asymptotic behavior as $N \to \infty$, are uniformly bounded above and below. In the ergodic aperiodic case and in certain null-recurrent cases convergence is demonstrated. It is shown that the null-recurrent case $\sum_{n=0}^{N} (m_h p_{ij}^{(n)} - m_j p_{kh}^{(n)})$ may fail to converge and, consequently, can be shown to be of central importance for the development of a potential theory for certain recurrent Markov chains.

1686

[Minnesota U. Dept. of Mathematics Minneapolis]

AN IMBEDDING OF CLOSED RIEMANN SURFACES IN EUCLIDEAN SPACE, by A. M. Garsia. [1960] 29p. incl. refs. (AFOSR-TN-60-1266) (AF 49(636)857) Unclassified

Presented at Internat'l. Colloquium of Differential Geometry and Topology, Zurich (Switzerland), June 1960.

Also published in Comment. Math. Helv., v. 35: 93-110, 1961.

A proof is given of the proposition that there exists a conformally equivalent C^∞ model for every compact Riemann surface of genus $g \geq 2$. Σ is a differentiable surface (a 2-dimensional countable manifold) and $ds^2 = E\,dx^2 + 2F\,dx\,dy + G\,dy^2$ is a metric Σ. A metric is used to introduce a conformal structure on Σ. The uniformizers are the local homeomorphic solutions of the Beltramic equation $w_{\bar{z}} = \mu w_z$ $(z = x + iy)$ where $\mu(z) = \frac{\frac{1}{2}(E - G) + iF}{\frac{1}{2}(E + G) + \sqrt{EG - F^2}}$.

1669

Minnesota U. [Dept. of Mathematics] Minneapolis.

IMBEDDINGS OF SOME CLOSED RIEMANN SURFACES BY CANAL SURFACES, by A. Garsia. [1960] 21p. (AFOSR-3244) (AF 49(638)857) Unclassified

Also published in Rend. Circ. Matem. Palermo, Series II, v. 9: 1-21, 1960.

Certain Riemann surfaces are imbedded in 3-space which can be obtained by joining together a finite number of spherical pieces. A method of constructing the Schottky uniformization of these surfaces expresses the uniformizing mappings and the conformal parameters in terms of the coordinates of the spheres supporting the surfaces and develops a limit form of the mappings (where the number of spheres tends to infinity). The results obtained are used to characterize the Schottky uniformization of canal surfaces and to construct imbeddings of some Riemann surfaces of genus one.

1690

Minnesota U. [Dept. of Mathematics] Minneapolis.

ON HOLOMORPHIC FAMILITIES OF FIBER BUNDLES OVER THE RIEMANNIAN SPHERE, by H. Röhrl. [1960] [47]p. incl. refs. (AFOSR-432) (AF 49(638)885) AD 253489; PB 155491 Unclassified

Also published in Mem. Coll. Sci., Kyoto U., Series A, v. 33: 435-477, 1960/61.

In the present paper question is raised for holomorphic families of fiber bundles $B \to V$ over a holomorphic family $V \xrightarrow{\pi} M$ of Riemannian spheres concerning holomorphic fiber bundles whose base space is the total space of a holomorphic fiber bunder with fiber P^1. It is found that the splitting theorem is locally still valid provided that a 1-codimensional analytic subset A of the parameter space M of the family is avoided. This theorem permits proof that the set of all points $t \in M$ fulfilling $\dim_{\mathbb{C}} H^0(V_t, \Omega(B_t)) \geq j$ for some integer j is an analytic subset of M. In addition, for any point $t_0 \in M$ there is a neighborhood U such that $H^0(\pi^{-1}(U), \Omega(B)) \to H^0(V_t, \Omega(B_t))$ is onto for all points $t \in U - A$ where A is a 1-codimensional analytic subset of U. This statement leads to a short proof of the theorem which states that the direct image $\pi_0(\Omega(B))$ is analytically coherent. The main result for holomorphic families $F \to V \xrightarrow{\pi} M$ of fiber bundles over a holomorphic family of Riemannian spheres whose structure group G is a reductive Lie group is that for any such family there is a 1-codimensional analytic subset A of M such that the restriction of F to $\pi^{-1}(M - A)$ admits a reduction of the structure group to N; in case M - A is simply connected, the structure group can be reduced to H itself.

1691

[Minnesota U. Dept. of Mathematics, Minneapolis]

A COMBINATORIAL LEMMA FOR COMPLEX NUMBERS, by G. Baxter. Nov. 1, 1960 [7]p. incl. diagrs. (Technical note no. 1) (AFOSR-TN-60-1419) (AF AFOSR-61-4) AD 248006; PB 153646 Unclassified

Also published in Ann. Math. Stat., v. 32: 901-904, Sept. 1961.

Let S be any permutation of 1 through n. Each fixed permutation S determines a set of points in the complex plane, which in turn determines a convex hull. Properties of the set of convex hulls generated as S ranges over all permutations are investigated. For example, the average number of sides in each of the convex hulls is found to be independent of the complex numbers. The combinatorial results are used to analyze properties of sums of complex-valued, independent and identically distributed random variables.

1692

Minnesota U. Heat Transfer Lab., Minneapolis.

EFFECT OF BUOYANCY FORCES ON MASS TRANSFER COOLING, by R. Eichhorn. Feb. 1960 [15]p. incl. diagrs. table. (Technical rept. no. 25) (AFOSR-TN-60-64) (AF 18(600)1226) AD 606468 Unclassified

Consideration is given to the constant property laminar boundary layer equations with free convection and mass transfer. It is shown that similar solutions are possible for blowing rate distributions varying as the distance from the leading edge raised to the power $\frac{n-1}{4}$ where n is the exponent in a power law surface temperature distribution. Solutions to the equations in the form of skin friction and heat transfer parameters, and velocity and temperature profiles are presented for the constant wall temperature case for a fluid with Pr = 0.73. The cases considered range from strong suction to strong blowing. Mass transfer has a pronounced effect on the heat transfer but only a slight effect on the skin friction. In light of the solutions presented these effects are shown to be physically rational. (Contractor's abstract)

1693

Minnesota U. Heat Transfer Lab., Minneapolis.

THE EFFECT OF MASS TRANSFER ON FREE CONVECTION, by R. Eichhorn. [1960] [4]p. incl. diagrs. table. (AF 18(600)1226) Unclassified

Published in Jour. Heat Transfer, v. 82: 260-263, Aug. 1960.

Consideration is given to the constant property laminar boundary layer equations with free convection and mass transfer. It is shown that similar solutions are possible for blowing rate distributions varying as the distance from the leading edge raised to the power $(n - 1)/4$ where n is the exponent in a power law surface temperature distribution. Solutions to the equations in the form of skin friction and heat-transfer parameters, and velocity and temperature profiles are presented for the constant wall temperature case for a fluid with Pr = 0.73. The cases considered range from strong suction to strong blowing. Mass transfer has a pronounced effect on the heat transfer but only a slight effect on the skin friction. In light of the solutions presented, these effects are shown to be physically rational. (Contractor's abstract)

1694

Minnesota U. [Heat Transfer Lab.] Minneapolis.

EXPERIMENTAL INVESTIGATIONS OF LAMINAR HEAT TRANSFER AND TRANSITION WITH FOREIGN GAS INJECTION — A 16° POROUS CONE AT M = 5, by C. J. Scott. Oct. 1960 [78]p. incl. illus. diagrs. table, refs. (UMRAL research rept. no. 174) (AFOSR-TN-60-1370) (AF 49(638)558) AD 258009 Unclassified

Experiments on two porous 16° cones at Mach number 5 are discussed which present the effects of helium and nitrogen injection on the stability of the laminar boundary layer. Large surface cooling and extreme injection rates are included. Heat transfer measurements with these two coolants are also presented. Since the experiments neither confirm nor invalidate the details of the theory, special emphasis is placed on the discussions of experimental procedures and data reduction methods. Analytical estimates of the effect of the solid tip followed by a uniform-injection cone are presented. An analysis of the effect of surface mass addition on viscous boundary layer-external flow interactions is included. A correlation of data on fluid flow through porous media in the slip-flow regime is presented. (Contractor's abstract)

1695

Minnesota U. Heat Transfer Lab., Minneapolis.

HEAT TRANSFER, TEMPERATURE RECOVERY, AND SKIN FRICTION ON A FLAT PLATE SURFACE WITH HYDROGEN RELEASE INTO A LAMINAR BOUNDARY LAYER, by E. R. G. Eckert, A. A. Hayday, and W. J. Minkowycz. Feb. 1961, 88p. incl. diagrs. refs. (Technical rept. no. 27) (AFOSR-TN-60-1417) (AF 49(638)-558) AD 255485 Unclassified

Presented at Heat Transfer Conf., Minsk (USSR), Jan. 1961.

Also published in Internat'l. Jour. Heat and Mass Transfer, v. 4: 17-29, Dec. 1961.

An analysis is presented for a 2-component laminar boundary layer on a surface with zero pressure gradient and with mass release. The system of partial differential equations describing the velocity, temperature, and concentration field is converted by a similarity transformation into a system of integral equations. Numerical solutions are obtained on electronic digital computers for air flow with hydrogen injection, for Mach numbers 0 to 12, for free-stream temperatures 123 to 2000°R, and for wall-to-free-stream temperature ratios from 1/2 to 8. Solutions for the condition of zero temperature gradient in the boundary layer at and normal to the wall surface lead to temperature recovery factors. The results are utilized to investigate the validity and accuracy of engineering correlations. The proposed correlations describe the reduction in heat flux into the wall surface and in skin friction reasonably well. No simple correlations have been found for the dependence of hydrogen mass fraction at the surface on the mass release rate and for the temperature recovery factor. (Contractor's abstract)

1898

Minnesota U. Hormel Inst., Austin.

THE ASSOCIATION OF α- AND β-CYCLODEXTRINS WITH ORGANIC ACIDS, by H. Schlenk and D. M. Sand. [1960] [8]p. incl. illus. diagrs. tables, refs. (AFOSR-TN-60-1222) [AF 18(803)18] AD 259488 Unclassified

Presented at 128th meeting of the Amer. Chem. Soc., Minneapolis, Minn., Sept. 15, 1955.

Also published in Jour. Amer. Chem. Soc., 83: 2312-2320, May 20, 1961.

Solubilities of organic acids have been determined in order to study their association with α- and β-cyclodextrins in water. The cyclodextrins increase the solubilities of acids which easily form crystalline inclusion complexes with them (caproic to lauric acid). Acids from which such complexes have not been obtained, or have been obtained only under extreme conditions, still may exhibit increased solubility (benzoic and iodobenzoic acids). Acids having still larger diameter are much less, if at all, affected (durylcarboxylic to 4-durylbutyric acids), and show extremely high component ratios cyclodextrin/acid in solution. The association of the acids which brings about the higher solubility obviously follows an inclusion mechanism. The compatibility of the whole acid molecule with the void inside the cyclodextrins is a deciding factor. Fatty acids follow the principle of preferential placing in crystalline dehydrated complexes of cyclodextrins. They are mostly crowded, while loose packing is encountered with benzoic and p-iodobenzoic acids. The iodide ion outranks other ions in preventing the association of organic acids with α-cyclodextrin. The optical rotations of cyclodextrins are changed when they are associated with other molecules. The changes appear to be related to the structure of the latter. (Contractor's abstract)

1697

Minnesota U. Inst. of Tech., Minneapolis.

ON THE DIFFERENTIABILITY OF FUNCTIONS OF SEVERAL VARIABLES, by J. Serrin. [1960] [14]p. incl. refs. (AFOSR-7) (AF 49(638)262) AD 250199 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 7: 359-372, 1961.

Let u = u(x) where x = 1 to n be a real valued locally summable function defined on an open region R of the n dimensional number space S. The differentiability of u is investigated when the gradient of the distribution associated with u is a measure.

1698

Minnesota U. [Inst. of Tech.] Minneapolis.

DIRICHLET'S PRINCIPLE IN THE CALCULUS OF VARIATIONS, by J. Serrin. [1960] [6]p. incl. refs. (AFOSR-3842) (AF 49(638)262) Unclassified

Also published in Partial Differential Equations; Proc. Symposium in Pure Mathematics, California U., Berkeley (Apr. 21-22, 1960), Providence, Amer. Math. Soc., v. 4: 17-22, 1961.

This paper deals with the simplest kind of multiple integral variational problem, that of minimizing an integral of the form $I[u] = \int_R f(x, u, u_x)dx$. Here R is a bounded open region in E_n, and $u = u(x) = u(x_1, \cdots, x_n)$ is a real-valued function defined in R and taking on given values on the boundary ∂R of R. The function $f = f)x, u, p)$ is assumed to be continuous for all values of its arguments and to satisfy the conditions $f \geq 0$, f convex in p. Concern is mainly with the principle that, in some fairly general sense, an extremal should furnish an absolute minimum to the integral. First some properties of the integral I[u], which are fundamental to the general problem, are discussed. Then the role of an extremal in the minimum problem is treated including at the same time some existence and differentiability theorems. Most of the proofs are omitted and will be published elsewhere. (Contractor's abstract)

1699

Minnesota U. [Rosemount Aeronautical Labs.] Minneapolis.

EVAPORATIVE FILM COOLING OF BLUNT-NOSE MODELS AT M = 7 WITH AIR STAGNATION TEMPERATURES UP TO 2200°R (Abstract), by R. Hermann, W. L. Melnik, and J. O. A. Stankevics. [1959] [1]p. [AF 49(638)190] Unclassified

Presented at meeting of the Amer. Phys. Soc., Ann Arbor, Mich., Nov. 23-25, 1959.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 134, Mar. 4, 1960.

Heat transfer to an evaporating water film continuously supplied through a single orifice at the stagnation point was measured on blunt-nose models in the 12 x 12 in. Hypersonic Wind Tunnel at Mach number 7 and air stagnation temperatures from 1000 to 2200°R. Details of the flow field, such as velocity gradient at the stagnation point, were determined from measurements of static pressure and compared with existing theories. The film thickness of the coolant is calculated along a 10-degree half angle cone for various mass flow rates. Also, the water flow rate necessary for cooling of a hemisphere from the stagnation point to a certain azimuth angle is obtained. Characteristic ice formation is observed at the rear of bodies caused by a condensation of water vapor in the diffusion boundary layer. Analysis of these phenomena is accomplished with the aid of the pressure-temperature diagram showing the thermodynamic state of the evaporating water film and the air in nozzle and cone flow.

1700

Minnesota U. Rosemount Aeronautical Labs., Minneapolis.

EVAPORATIVE FILM COOLING OF BLUNT BODIES IN HYPERSONIC FLOW AND ITS APPLICATION TO REENTRY VEHICLES, by R. Hermann. [1960] [27]p. incl. illus. diagrs. table. (AFOSR-1446) (AF 49(638)-190) Unclassified

Also published in Proc. Eleventh Internat'l. Astronaut. Congress, Stockholm (Sweden) (Aug. 15-20, 1960), Vienna, Springer-Verlag, v. 1: 215-226, 1961.

Evaporative film cooling on blunt nose models has been investigated in a 12 in. x 12 in. hypersonic wind tunnel at Mach number 7 with stagnation temperatures up to 2500°R. Water as coolant was supplied continuously through orifices located near the stagnation point of a hemisphere-cylinder (3 in. diam) and a blunt cone with 10° half angle (base diam 5.5 in.) forming an evaporating water film covering the body. This results in nearly uniform wall temperatures about 30°R below the local boiling temperature of the water. Characteristic ice formation was observed to develop along the cone and the cylinder body. This is caused by a condensation and/or sublimation of the water vapor, initially produced along the front portion of the body. Analysis of these phenomena is accomplished with the aid of a pressure versus temperature diagram showing the thermodynamic state of the air flow together with the water saturation line. Measured values of the wall temperature permit the calculation of the water vapor mass fraction at the interface. A theoretical analysis of similarity parameters was developed for blunt bodies including the effects of mass transfer on heat transfer and skin friction for

Lewis number unity. It assumes laminar (Couette) flow in the coolant film with the shear stress at the interface being equal to that for a laminar gas boundary layer on a fixed permeable wall. For a stagnation temperature of 1740°R the analytical interface temperature (about 550°R) was in good agreement with measured values (within + 10°F) of wall temperature from stagnation point to the equator. Evaporation reduced the heat transfer by 25% as compared to the case of no mass transfer. In addition, water vapor mass fraction at the interface, the film thickness (0.001 to 0.008 in.), and local evaporation rates were calculated as functions of arc length for T_o = 1200°R and 2000°R. Application of the evaporative film cooling method and its advantages for cooling of re-entry satellite vehicles are discussed. (Contractor's abstract)

1701

Minnesota U. Rosemount Aeronautical Labs., Minneapolis.

DESIGN, CALIBRATION AND SIMULATION CAPABILITY OF THE ROSEMOUNT AERONAUTICAL LABORATORIES HIGH TEMPERATURE HYPERSONIC FACILITY, by R. Hermann, J. O. A. Stankevics and others. July 1960, 39p. incl. illus. (WADD-TN-60-108) (Sponsored jointly by Aeronautical Research Laboratories under AF 33(616)6077 and AF 33(616)473 and Air Force Office of Scientific Research under AF 49-(638)190) AD 246393 Unclassified

The high temperature hypersonic facility of the Rosemount Aeronautical Labs., Minnesota U. is described. The discussion of failures, improvement and additions to the facility outlines the progress through the years since original construction. Performance graphs for the facility are included as well as a discussion of related instrumentation and optical equipment. The facility presently operates with a 12 in. by 12 in. test section at Mach number 7, with stagnation pressures from 50 psia to 150 psia and stagnation temperatures from 1000°R to 3000°R. Potential development of the facility is suggested in the performance curves and discussed in the conclusion. (Contractor's abstract)

1702

Minnesota U. [School of Chemistry] Minneapolis.

NUCLEAR AND ELECTRON SPIN RESONANCE, by J. E. Wertz. Final rept. Feb. 29, 1960, 67p. incl. illus. refs. (AFOSR-TR-60-69) (AF 18(600)479) AD 237004; PB 147917 Unclassified

It is shown that for magnesium oxide an electron spin resonance spectra may be used to detect and give detailed descriptions of many of the known types of defect centers. It has been possible to make numerous correlations with other physical properties.

1703

Minnesota U. [School of Chemistry] Minneapolis.

STUDIES OF ION-SOLVENT AND ION-ION INTERACTIONS USING NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY, by A. Carrington, F. Dravnieks, and M. C. R. Symons. [1959] [9]p. incl. diagrs. table, refs. (AF 18(600)479) Unclassified

Published in Molec. Phys., v. 3: 174-182, Mar. 1960.

Chemical shifts in the fluorine nuclear resonance were measured for fluoride ion in a variety of environments. The shift varies linearly with the mole-fraction of organic solvent and is dependent upon the nature and concentration of added cations and anions. In contrast, the value for the cesium resonance from solutions of cesium salts is independent of the choice of solvent. Large, linear, chemical shifts are observed when other electrolytes are added, the effect being almost entirely due to the anions. (Contractor's abstract)

1704

Minnesota U. [School of Chemistry] Minneapolis.

THE ROLE OF THE TRIPLET STATE IN REACTIONS SENSITIZED BY CHLOROPHYLL, by R. Livingston and A. C. Pugh. [1959] [5]p. incl. diagr. refs. (AFOSR-TN-60-66) (AF 18(600)1485) AD 233738 Unclassified

Also published in Faraday Soc. Discussions, No. 27: 144-148, 1959.

A possible mechanism of photosynthesis involves an inductive-resonance migration of energy of excitation between chlorophyll molecules leading to the trapping of this energy by a pigment molecule. This molecule is so situated that it can initiate the sequence of biochemical acts that constitute the secondary mechanism of photosynthesis. It is sometimes assumed that this pigment molecule is complexed with a substrate molecule. In studying, in solution, the quenching of the triplet state of chlorophyll by retinene, it was observed that the rate of disappearance of the triplet approaches a limiting value as the retinene concentration is increased. A possible explanation of this result is that retinene and chlorophyll form a moderately stable addition compound whose triplet state has a half-life about 1/6 of that of simple chlorophyll. (Contractor's abstract)

1705

Minnesota U. School of Chemistry, Minneapolis.

CARBON-13 HYPERFINE SPLITTINGS IN SEMIQUINONES, by D. C. Reitz, F. Dravnieks, and J. E. Wertz. Aug. 31, 1960 [6]p. incl. diagrs. (AFOSR-TN-60-929) (AF 18(603)17) AD 241915; PB 150238 Unclassified

Also published in Jour. Chem. Phys., v. 33: 1880-1881, Dec. 1960.

The ESR spectra of 2,5-dihydroxysemiquinone and semiquinone are given. They exhibit hyperfine splittings consistent with the number of ring protons on each molecule. Also, there are lines of weak intensity in both spectra which may be attributed to the natural abundance of C^{13} in ring C atoms.

1706

Minnesota U. School of Chemistry, Minneapolis.

WEAK COMPLEXES OF THE SODIUM ION IN AQUEOUS SOLUTION STUDIED BY NUCLEAR SPIN RESONANCE, by O. Jardetzky and J. E. Wertz. [1960] [6]p. incl. diagrs. tables, refs. (AFOSR-1142) (In cooperation with Harvard U. Medical School, Boston, Mass.) [AF 18(603)17] AD 260868 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 318-323, Jan. 20, 1960.

The nuclear spin resonance absorption of the Na^{23} ion in aqueous solution has been studied as a function of concentration, viscosity and nature of the anionic species. Broadening of the absorption line width and decrease in the amplitude have been observed at higher concentrations (2-3 N) with several of the anions tested, notably phosphates, hydroxy- and keto-acids and alcohols. These effects are attributed to an interaction of the Na^{23} nuclear quadrupole with an electric field gradient and are interpreted in terms of the formation of weak complexes of Na with the anions in question. (Contractor's abstract)

1707

Minnesota U. School of Chemistry, Minneapolis.

ELECTRON SPIN RESONANCE STUDIES OF AUTOXIDATION OF 3,4-DIHYDROXYPHENYLALANINE, by J. E. Wertz, D. C. Reitz, and F. Dravnieks. [1960] [11]p. incl. diagrs. refs. (AFOSR-1143) [AF 18(603)17] AD 260870 Unclassified

Also published in Free Radicals in Biological Systems; Proc. Symposium, Stanford U., Calif. (Mar. 21-23, 1960), New York, Academic Press, 1961, p. 183-193.

Although identification of the radicals occurring in dopa (3,4-dihydroxyphenylalanine) oxidation is incomplete and tentative, the data do seem to indicate that both indole formation and side-chain degradation take place. The degradation seems relatively insensitive to conditions, whereas the indole formation seems far more sensitive. The experiment with 5,6-dihydroxyindole does not necessarily rule out the formation of radicals past this stage on the road to melanin formation, but it does indicate that it may be difficult to find proper conditions for their stabilization. If the assignment of radicals to the two sequences is correct, some progress may be expected in understanding the autoxidation of dopa. (Contractor's abstract)

1708

Minnesota U. School of Chemistry, Minneapolis.

ELECTRON SPIN RESONANCE STUDIES OF SOME QUINONE REACTIONS, by D. C. Reitz, J. R. Hollahan and others. [1960] [2]p. incl. diagr. table. (AFOSR-1144) [AF 18(603)17] AD 260869 Unclassified

Also published in Jour. Chem. Phys., v. 34: 1457-1458, Apr. 1961.

In connection with an investigation of the reaction products of p-benzoquinone, observations are made which prove that alkoxyl attack does occur in alcoholic solvents and that spin exchange between the 2 halves of a coupled product is slow if 1 does form. The spectra obtained from a solution of p-benzoquinone in ethanol or methanol have exactly the same splitting and g-values as that observed for 2,5-diethoxysemiquinone and 2,5-dimethoxysemiquinone, thus, eliminating the possible rejection of alkoxyl attack on halogen-substituted quinones. After preparing an authenic sample of a hydroquinone type reduction product and observing its spectrum in 10% NaOH it was reasoned that the simplest explanation of the spectrum is that spin exchange between the 2 halves of the molecule is slow, and that the 8 lines originate for the 3 nonequivalent protons on 1/2 of the molecule. In alcoholic solution the same product exhibits hfs which indicates that alkoyxl attack has occurred.

1709

Minnesota U. School of Chemistry, Minneapolis.

PROTON HYPERFINE SPLITTINGS AND SPIN DENSITIES OF PENTAPHENYLCYCLOPENTADIENYL, by D. C. Reitz. [1960] [2]p. incl. diagrs. table. [AF 18(603)17] Unclassified

Published in Jour. Chem. Phys., v. 34: 701-702, Feb. 1961.

A dilute liquid solution of the radical pentaphenylcyclopentadienyl exhibits a symmetrical hyperfine spectrum of at least 33 lines separated by approximately 0.3 oe. The intensity of each line decreases as its distance from the center of the spectrum decreases. This pattern is to be expected if the ratios of the spin densities at the o, m, and p positions were similar to the same ratios in the odd-alternate radical triphenylmethyl. The π-spin densities ρ_i at various positions of pentaphenylcyclopentadienyl are calculated from both simple Hückel MO theory and Pauling-Wheland bond theory. The pattern of spin-densities resulting from these calculations are close to the results obtained for odd-alternate systems; the most conspicuous difference being the positive sign of ρ_4. The twisted valence bond results are in good agreement with experimental results.

1710

Minnesota U. [School] of Chemistry, Minneapolis.

STRUCTURE OF CELLOBIOSE, by R. A. Jacobson, J. A. Wunderlich, and W. N. Lipscomb. [1959] [2]p. incl. diagrs. (AFOSR-TN-60-558) (AF 49(638)485) AD 237360 Unclassified

Also published in Nature, v. 184: 1719-1720, Nov. 28, 1959.

The three-dimensional structure of cellobiose is studied by single-crystal x-ray diffraction methods. The crystals are monoclinic with two molecules in a unit cell with parameters: a = 10.94, b = 13.05, c = 5.11A, and β = 90.0° in the space group $P2_1$. The atomic arrangement in (001) plane figure is obtained by quantitative analysis of a modification of the three-dimensional Patterson function: $P'(u,v,w) = \int \Delta\rho(x,y,z) \cdot \Delta\rho(x+u, y+v, z+w)dV \propto \Sigma_{hki} \frac{\sin^2}{\lambda^2} \theta |F_{hkl}|^2 \exp[2\pi i(hu + kv + lw)]$.

1711

Minnesota U. School of Chemistry, Minneapolis.

THE STRUCTURE OF ψ-CONHYDRINE, by H. S. Yanai and W. N. Lipscomb. [1958] [8]p. incl. diagrs. tables. (AFOSR-TN-60-559) [AF 49(638)485] AD 238807 Unclassified

Also published in Tetrahedron, v. 6: 103-108, 1959.

The 3-dimensional structure, except for the absolute configuration, of ψ-conhydrine has been determined in an x-ray diffraction study of ψ-conhydrine hydrobromide. In agreement with recent chemical evidence, the OH and propyl groups are found to be trans to each other, and in the equatorial position relative to the saturated 6-membered ring. The unit cell is orthorhombic in the space group D $4/2\text{-}P2_12_12_1$, contains four $C_8H_{18}NOBr$, and has dimensions a = 15.15, b = 9.28, c = 7.72A. Refinement, including anisotropic thermal motion, has yielded values of $R = \Sigma||F_o| - |F_c||/\Sigma|F_o| = 0.109$ and $r = \Sigma w(|F_o|^2 - |F_c|^2)^2/\Sigma w|F_o|^4 = 0.056$ for the 920 observed reflections. (Contractor's abstract)

1712

Minnesota U. [School] of Chemistry, Minneapolis.

STRUCTURAL INVESTIGATION OF LARGE MOLECULES BY X-RAY DIFFRACTION, by W. N. Lipscomb. Final rept. [1960] 3p. (AFOSR-TR-60-31) (AF 49(638)-485) AD 236990; PB 147659 Unclassified

A brief summary is given of the accomplishments in the study of the structures of large molecules by x-ray diffraction methods. An abstract is presented on the structure of ψ-conhydrine by H. S. Yani and W. N. Lipscomb (item no. 1711, Vol. IV). Research also completed was the study of the structure of cellobiose by R. A. Jacobson, A. Wunderlich, and W. N. Lipscomb (item no. 1710, Vol. IV).

1713

Minnesota U. School of Chemistry, Minneapolis.

POLAROGRAPHIC AND ACID PROPERTIES OF THORIUM PERCHLORATE IN ACETONITRILE, by I. M. Kolthoff and S. Ikeda. [1960] [7]p. incl. diagrs. tables, refs. (AFOSR-90) (AF 49(638)519) AD 261246 Unclassified

Also published in Jour. Phys. Chem., v. 65: 1020-1026, June 1961.

Thorium perchlorate in acetonitrile (AN) behaves like a relatively strong dibasic acid with a first dissociation constant of about 10^{-6} which is slightly less than that of sulfuric acid. The second dissociation constant is very much greater than that of sulfuric acid. Indication has been obtained that the $Th(ClO_4)_2^{2+}$ ion is relatively stable in AN. The neutralization product formed upon titration with diphenylguanidine and the insoluble reaction product formed in electrolysis at -1.8 both contain about 2 ClO_4^- per one thorium. The height of the polarographic wave of thorium perchlorate in AN is proportional to concentration. The reduction involves the evolution of hydrogen and not the formation of thorium amalgam. The value of the limiting current corresponds to the formation of a reaction product which contains about 2 ClO_4^- per one thorium. (Contractor's abstract)

1714

Minnesota U. School of Chemistry, Minneapolis.

ESTIMATE OF THE NUCLEAR MOMENT OF Ni^{61} FROM ELECTRON SPIN RESONANCE, by J. W. Orton, P. Auzins, and J. E. Wertz. [1960] [2]p. incl. diagrs. (AFOSR-TN-60-708) [AF 49(638)683] Unclassified

Also published in Phys. Rev., v. 119: 1691-1692, Sept. 1, 1960.

The electron spin resonance spectra of nickel and cobalt have been studied in single crystals of MgO. Hyperfine structure was detected from Ni^{61} isotope in the spectrum of Ni^{+2} and the hyperfine splitting constant A^{61} found to be $(8.3 \pm 0.4) \times 10^{-4}$ cm^{-1}. X-irradiation of cobalt-containing crystals results in the formation of Co^{+1} (isoelectronic with Ni^{+2}). The hyperfine

splitting constant A^{59} is (54.0 ± 0.2) x 10^{-4} cm^{-1}. Comparison between A^{59} and A^{61} yields a value of 0.30 ± 0.02 nm for the nuclear moment of Ni^{61}. (Contractor's abstract)

1715

Minnesota U. School of Chemistry, Minneapolis.

ELECTRON SPIN RESONANCE STUDIES OF IMPURITY IONS IN MAGNESIUM OXIDE, by J. W. Orton, P. Auzins and others. [1960] [15]p. incl. diagrs. table, refs. (AFOSR-TN-60-1234) (AF 49(638)683) Unclassified

Also published in Proc. Phys. Soc. (London), v. 78: 554-568, Oct. 1961.

The univalent ions Fe^{1+}, Co^{1+} and Ni^{1+} have been produced by ultraviolet or x-irradiation of impure MgO crystals. The electron spin resonance spectra of these ions are compared with those of the isoelectronic ions Co^{2+}, Ni^{2+} and Cu^{2+} which they resemble closely. The spectra of Fe^{1+}, Co^{1+} and Ni^{2+} show line-width effects which may be interpreted as being due to the presence of small distortions in the cubic crystal lattice. A detailed report of the $3d^9$ configuration in a cubic field is given. There is a transition at low temperature from an isotropic to an anisotropic spectrum, presumably due to the "freezing in" of Jahn-Teller distortions. Observation of hyperfine structure from Ni^{61} has made it possible to estimate the nuclear moment by comparison with the observed hyperfine structure from Co^{1+}. The ease of formation and stability of these univalent ions is shown to be related to the concentration of positive ion vacancies and to the concentration of trapped hole centers. (Contractor's abstract)

1716

Minnesota U. [School of Chemistry] Minneapolis.

DOUBLE-QUANTUM ELECTRON SPIN RESONANCE TRANSITIONS OF NICKEL IN MAGNESIUM OXIDE, by J. W. Orton, P. Auzins, and J. E. Wertz. [1959] [2]p. incl. diagrs. (AFOSR-3585) [AF 49(638)683] Unclassified

Also published in Phys. Rev. Ltrs., v. 4: 128-129, Feb. 1, 1960.

Former investigations have studied the electron spin resonance spectrum of Ni^{+2} as an impurity in single crystals of MgO at x band. It is the aim of this study to report the observation of a double-quantum absorption between the $S_z = -1$ and $S_z = +1$ levels. The Ni^{+2} ions are present in approximately cubic crystal surroundings, the ground state having effective spin S = 1. At 77°K, the spectrum consists of an isotropic broad line with a sharp line superimposed on its center. The width of the broad line may be due to the presence of small distortions in the MgO lattice; the sharp line has a width similar to that of lines from other impurity ions in the same crystal. At low microwave powers the sharp central line is found to be inverted. As the power is increased, this inverse line is reduced in amplitude and then changes to the normal positive line which is interpreted as arising from the simultaneous absorption of two quanta the absorption ions being excited from the $S_z = -1$ to the $S_z = +1$ state.

1717

Minnesota U. School of Chemistry, Minneapolis.

THE REACTION OF ALKYLMERCURIC IODIDES WITH NON-HALOGEN ACID, by M. M. Kreevoy and R. L. Hansen. [1960] [17]p. incl. diagrs. tables, refs. (AFOSR-TN-60-750) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)711 and National Science Foundation) AD 253819 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 626-630, Feb. 5, 1961.

A study of the relative reactivities of alkylmercuric iodides toward aqueous nonhalogen acids gives the following order of reactivities: cyclo-C_3H_5- >> CH_3- > n-C_3H_7 > iso-C_3H_7 > t-C_4H_9. These results, along with the thermodynamic quantities of activation, are consistent with a rate-determining step in which the carbon-mercury bond is broken and the new carbon-hydrogen bond is made. For the open chain compounds the former process is nearly complete while the latter is just beginning in the transition state. The entropy of activation and the solvent isotope effect for the cyclopropyl case suggest certain quantitative differences.

1718

[Minnesota U. School of Chemistry, Minneapolis.]

THE EFFECT OF STRUCTURE ON THE RATE OF DEOXYMERCURATION, by M. M. Kreevoy. [1960] 3p. (AFOSR-TN-60-751) [AF 49(638)711] Unclassified

The nature of the rate-determining step and its transition state which succeed the reversible protonation of the oxygen atom in acid deoxymercuration is discussed. A graph shows the potential energy of the transition state as a function of the angle (θ) of the carbon-oxygen bond with respect to the carbon-mercury bond. There is some evidence that the transition state for oxymercuration contains more carbonium ion character than that for deoxymercuration.

1719

Minnesota U. School of Chemistry, Minneapolis.

THE INFRARED SPECTRUM OF 2-METHOXYETHYLMERCURIC IODIDE AND ITS TETRADEUTERIO ANALOGUE, by M. M. Kreevoy and L. T. Ditsch. [1960] 16p. incl. diagrs. tables, refs. (AFOSR-TN-60-752) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)711 and National Science Foundation under NSF-G5434) AD 251401
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 6124-6126, Dec. 5, 1960.

The fundamental vibrational frequencies for 2-methoxyethylmercuric iodide and 1,1,2,2-tetradeuterio-2-methoxyethylmercuric iodide have been obtained from the infrared spectra of 2 solids. The frequencies obtained are consistent with the assumption that the all-trans isomer is preferred in the solid state. On melting a few new peaks appear, but it is concluded that the all-trans isomer is still the most stable in the melt.

1720

Minnesota U. School of Chemistry, Minneapolis.

SECONDARY HYDROGEN ISOTOPE EFFECTS ON DEOXYMERCURATION, by M. M. Kreevoy and L. T. Ditsch. [1960] [3]p. incl. diagrs. refs. (AFOSR-TN-60-753) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)711 and National Science Foundation under NSF-G5434) AD 251402
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 6127-6128, Dec. 5, 1960.

The ratio k_H/k_D, for the acid cleavage of $CH_3OCH_2CH_2HgI$ and its 1,1,2,2-tetradeuterio analog is 1.06 ± 0.02. This isotope effect, combined with the known vibrational frequencies of the substrates and metal-olefin complexes, preclude the extensive participation of a mercuric-olefin complex in the transition state resonance hybrid. The small isotope effect also tends to preclude extensive carbonium ion character in the transition state. It can be accomodated by a substrate-like model of the transition state in which the methylene-oxygen bond is breaking. (Contractor's abstract)

1721

Minnesota U. School of Chemistry, Minneapolis.

THE REACTION OF ALKYLMERCURIC IODIDES WITH ACID IN THE PRESENCE OF OXYGEN, by M. M. Kreevoy and P. L. Hansen. [1960] [2]p. incl. diagr. (AFOSR-430) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)711 and National Science Foundation under NSF-G5434) AD 260871
Unclassified

Also published in Jour. Phys. Chem., v. 65: 1055-1056, June 1961.

Studies showed that the reactions of isopropyl and t-butyl mercuric iodides with aqueous, non-halogen acids are profoundly influenced by the presence of O_2. Reactions were carried out in sealed ampoules containing 3 ml of aqueous solution with a hundred-fold excess of O_2. The progress of each reaction was followed by observing the optical density at 2700A. In each isopropylmercuric iodide experiment, 1/2 mol of HgI_2 was produced per mol of starting material. Good pseudo first-order kinetics were observed and reported graphically. Reaction rates as a function of $HClO_4$ concentration and temperature were also studied for the isopropyl compound.

1722

Minnesota U. School of Chemistry, Minneapolis.

EXPERIMENTAL AND THEORETICAL EVALUATIONS OF THE BAKER-NATHAN EFFECT, by M. M. Kreevoy. [1959] [10]p. incl. diagrs. tables. (AFOSR-1878) [AF 49(638)711]
Unclassified

Also published in Tetrahedron, v. 5: 233-242, Jan. 1959.

It is shown that the Baker-Nathan effect is something peculiar to hydrogen atoms. This is done by comparing h, an empirically determined constant in the equation $B = h(n - n_0)$ where n is the number of α hydrogens in a given compound and n_0 is the number in a standard compound, with h' in the equation $B = h'(n' - n_0')$ where n' is the number of alkyl groups directly attached to a functional group. It is shown that the Baker-Nathan effect is related to the resonance effect arising from conjugation and that if the α-hydrogen bonding model is used, h equals 0.07 times the resonance effect of a single $\alpha\beta$-unsaturated substituent for acetal hydrolysis, olefin hydrogenation, and carbonyl hydrogenation. It is 0.13 times this resonance effect for the hydrogenation of acetylenes and alkanes. The facts further suggest that a carbon-hydrogen bond adjacent to a π orbital should be linked to that orbital through a non-zero resonance integral. This suggests that the Baker-Nathan effect should be a fairly linear function of the number of carbon-hydrogen bonds adjacent to the π orbital.

1723

Minnesota U. School of Chemistry, Minneapolis.

REACTION OF 1-IODOMERCURI-2-PROPANOL AND

ITS METHYL ETHER WITH NON-HALOGEN ACIDS, by M. M. Kreevoy. [1958] [5]p. incl. diagrs. refs. (AFOSR-1879) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)711] and National Science Foundation under NSF-G5434)
Unclassified

Presented in part at meeting of the Amer. Chem. Soc., San Francisco, Calif., Apr. 1958.

Also published in Jour. Amer. Chem. Soc., v. 81: 1099-1103, Mar. 5, 1959.

The reaction of $CH_3CH(OR)CH_2HgI$ with perchloric acid and acetic acids was examined for R = H and R = CH_3. The products are propylene, HgI_2, HOR and $CH_3CHORCH_2Hg^{\oplus}$ (the latter either as the perchlorate or the acetate). The reaction rate is proportional to the hydronium ion concentration in dilute solution and is independent of the concentration of molecular acetic acid. For both R = H and R = CH_3, the reaction is faster in D_2O than in H_2O. These facts suggest very strongly that the first step in this reaction is a fast, reversible protonation of the substrate oxygen and that this is followed by a rate-determining step in which no covalent bonds to solvent or acetate ion are formed. The exact nature of the rate-determining step and the structure of the transition state are not yet known. (Contractor's abstract)

1724

Minnesota U. School of Chemistry, Minneapolis.

THE NATURE OF THE RATE-DETERMINING STEP IN DEOXYMERCURATION, by M. M. Kreevoy and F. R. Kowitt. [1959] [7]p. incl. diagrs. table, refs. (AFOSR-1899) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)711] and National Science Foundation under NSF-G5434)
Unclassified

Presented at 135th meeting of the Amer. Chem. Soc., Organic Chem. Div., Boston, Mass., Apr. 1959.

Also published in Jour. Amer. Chem. Soc., v. 82: 739-745, Feb. 5, 1960.

For deoxymercuration of α-2-methoxycyclohexylmercuric iodide by non-halogen acid $\Delta H^{\ddagger}$ is 17.75 ± 0.19 kcal mol^{-1} and $\Delta S^{\ddagger}$ is 4.6 ± 0.6 cal mol^{-1} $degrees^{-1}$. For the same reaction of the β-isomer $\Delta H^{\ddagger}$ is 26.2 ± 0.7 kcal mol^{-1} and $\Delta S^{\ddagger}$ is 4.5 ± 2.0 cal mol^{-1} $degrees^{-1}$. In both cases, strong evidence is presented that a fast, prototropic equilibrium precedes the rate-determining step. From this it is concluded that the rate-determining step in deoxymercuration is the conversion of the protonated substrate to the mercuric olefin complex, and that the α-isomer has the trans configuration. (Contractor's abstract)

1725

Minnesota U. [School of Chemistry] Minneapolis.

DIFFUSION IN INHOMOGENEOUS MEDIA, by S. Prager. Mar. 1960, 22p. (Technical rept. no. 1) (AFOSR-TN-60-187) (AF 49(638)720) AD 234584 Unclassified

Also published in Jour. Chem. Phys., v. 33: 122-127, July 1960.

Methods are given for the calculation of effective diffusion coefficients for inhomogeneous media, in which the actual diffusion coefficient varies from point to point in a random manner. An exact result is obtained in the form of an infinite series involving correlations between diffusion coefficients at n different points. A procedure for deriving approximate expressions involving only 2-point correlations is also developed, and applied, in particular, to the important special case of diffusion through a porous material. (Contractor's abstract)

1726

Minnesota U. School of Physics, Minneapolis.

EXPERIMENTS ON DYNAMIC POLARIZATION OF PROTONS IN POLYETHYLENE BY THE SOLID EFFECT: A PROPOSED POLARIZED PROTON TARGET, by C. [F.] Hwang and T. M. Sanders, Jr. [1960] [4]p. incl. diagrs. table. (AFOSR-119) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)811 and Atomic Energy Commission under AT(11-1)50)
Unclassified

Also published in Proc. Seventh Internat'l. Conf. on Low Temperature Phys., Toronto U. (Canada) (Aug. 29-Sept. 3, 1960), Univ. of Toronto Press, 1961, p. 148-151.

Also published in Helv. Phys. Acta, Suppl. 6: 122-123, 1961.

Targets for scattering experiments, composed of polarized nuclei (particularly protons), are considered. Desirable proton target criteria, such as the magnitude of the polarization, the effects of the beam on the polarization, the characteristics of the matrix in which the protons are to be located, etc. are reviewed. Within the framework of these criteria, static and dynamic methods for obtaining polarized targets are evaluated. A method utilizing the "soft effect" is found to be promising in the solid effect, a microwave magnetic field is applied to a target containing paramagnetic centers, and the nuclei are polarized through spin-flip processes. A target consisting of radiation damaged polyethylene is described.

1727

Minnesota U. School of Physics, Minneapolis.

NEW ELECTRON SPIN RESONANCE SPECTRUM IN ANTIMONY-DOPED GERMANIUM, by R. E. Pontinen and T. M. Sanders, Jr. [1960] [3]p. incl. diagr. [AF 49(638)811] Unclassified

Published in Phys. Rev. Ltrs., v. 5: 311-313, Oct. 1, 1960.

The observation of an apparently new electron spin resonance spectrum in antimony-doped Ge in the liquid helium temperature range is reported. The spectrum consists of 4 lines, each with an anisotropic g-factor with axial symmetry about the [111] direction. The principal values of the g-tensor are determined to be $g_{\parallel} = 0.820 \pm 0.008$ and $g_{\perp} = 1.992 \pm 0.007$. The details of the spectrum are described and several possible mechanisms which might be responsible for the spectra are discussed. However, none of the models seems to be consistent with all the data.

1728

Missouri U. Dept. of Mathematics, Columbia.

[INVESTIGATIONS ON PROBABILITY, DIFFERENTIAL EQUATIONS, AND CALCULUS OF VARIATIONS] Final rept. June 1954-June 1960 [10]p. incl. refs. (AFOSR-TR-60-91) (AF 18(600)1108) Unclassified

Most of the work performed under this contract has been in three broad areas: (1) maximum likelihood estimation of ordered parameters, and minimizing integrals in classes of monotone functions, (2) topological dynamics, and (3) differential equations. Studies in the first area originated in the following type problem: for n a positive integral, and for c = 1, 2, ···, n, independent trials are made of an event with probability p_i.

The scope of the problem was later broadened to include existence and uniqueness of functions of several variables, an extension of the Radon-Nikodym derivative, and the general problem of minimizing a convex function of several variables. Work on the second phase was concerned with extensions of homeomorphism and it was shown that no unstable self-homeomorphism of a 2-cell exists. The work in the latest phase of the contract was on real second order non-linear equations.

1729

Missouri U. [Dept. of Mathematics] Columbia.

THE NONEXISTENCE OF EXPANSIVE HOMEOMORPHISMS ON A CLOSED 2-CELL, by J. F. Jakobsen and W. R. Utz. [1960] [3]p. (AFOSR-2798) (AF 18-(600)1108) Unclassified

Also published in Pacific Jour. Math., v. 10: 1319-1321, 1960.

A homeomorphism T of a metric space X onto itself is said to be expansive provided there exists a positive real number a such that x, y ∈ X with x ≠ y implies the existence of an integer n for which dist $(T^n x, T^n y) > a$. For example, the shift transformation in symbolic dynamics is expansive and acts upon a space homeomorphic to the Cantor discontinuum; actually, this is the historical origin of the property. It is proved that no homeomorphism of a closed 2-cell onto itself is expansive by showing that no homeomorphism of a simple closed curve onto itself is expansive. It is also announced without proof that the shift transformation on the inverse limit space of any continuous map of an arc onto itself cannot be expansive. It has been previously observed that an arc cannot carry an expansive homeomorphism. The question of whether a closed n-cell can carry an expansive homeomorphism has thus a negative answer for n = 1 and n = 2; the question remains open for n > 2. (Math. Rev. abstract)

1730

Missouri U. [Dept. of Mathematics] Columbia.

PROPERTIES OF THE SOLUTIONS OF $u'' + g(t)u^{2n-1} = 0$, by W. R. Utz. July 1960, 10p. (AFOSR-TN-60-810) (AF 49(638)754) AD 241416; PB 150194 Unclassified

Also published in Monatsh. Math., v. 66: 55-60, Jan. 1962.

Two theorems are presented which give sufficient conditions for the oscillation of all solutions of $u'' + g(t)u^{2n-1} = 0$, not identically zero, of a real nonlinear equation. In this equation, n is a positive integer, g(t) (> 0 for all real t) is continuous, and $g'(t) \leq 0$ for all $t \geq T$, then if u(t) is any solution of the equation valid for all $t \geq T$, $|u(t)|$ and $|u'(t)|$ are bounded provided $\lim_{t\to\infty} g(t) > 0$. The solution is called oscillatory if it has positive maxima and negative minima, and hence zeros, for arbitrarily large values of t.

1731

Mount Zion Hospital, San Francisco, Calif.

A STERECTAXIC TECHNIQUE IN MAN ALLOWING MULTIPLE SPATIAL AND TEMPORAL APPROACHES TO INTRACRANIAL TARGETS, by B. Feinstein, W. W. Alberts and others. [1959] [13]p. incl. illus. diagrs. (AFOSR-TN-60-1456) (Bound with its AFOSR-TR-59-58; AD 216107 as Appendix I) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)48, Harry Freund Memorial Foundation, and Research Committee of Mount Zion Hospital and Medical Center) AD 247720 Unclassified

Also published in Jour. Neurosurg., v. 17: 708-720, 1960.

This paper describes techniques in the use of a simple, accurate, and flexible stereotaxic instrument which

allows approach to any subcortical area by any path, methods of allowing repeated approach to the same or other subcortical areas on the basis of a single radiographic localization, and production of thermal lesions. The stereotaxic instrument consists of an inner square frame and an outer semicircular frame bearing an electrode carrier. The inner frame fixes on the calvaria at three points. The outer semicircular frame rotates about tubular support bars at its diameter. The semicircular outer frame and the electrode carrier determine the spherical coordinate system by which the electrode is directed to the target. The technique described allows for subsequent return to targets without the necessity for relocation. Lesion production can be carried out under local anesthesia and usually without premedication. Once the electrode has been positioned, the target area is stimulated electrically with square current pulses, the polarity reversing with each succeeding pulse. This permits checks on localization. Untoward responses indicate the undesirability of a lesion at the site of the electrode.

1732

Mount Zion Hospital, San Francisco, Calif.

THRESHOLD STIMULATION OF THE LATERAL THALAMUS AND GLOBUS PALLIDUS IN THE WAKING HUMAN, by W. W. Alberts, E. W. Wright, Jr. and others. May 7, 1960, 7p. incl. illus. tables, refs. (AFOSR-1089) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)48 and Office of Naval Research under Nonr-296801) AD 252678 Unclassified

Also published in Electroencephalog. and Clin. Neurophysiol. Jour., v. 13: 68-74, 1961.

Threshold stimulation of 4 subcortical targets in unanesthetized Parkinson patients is described. The targets are in the globus pallidus and the lateral nuclear mass of the thalamus; coordinates are specified. Responses include tremor, coordinated movements, sensation, and miscellaneous responses involving emotion, etc., tremor being the most frequent response in all targets. Statistical investigation shows a significant difference between pallidal and thalamic targets with respect to the frequency of the various responses. It is suggested that parkinsonian symptoms may appear because of unbalanced activity between interacting portions of the central nervous system which results from a combination of the pathological lesion and normal brain cell loss with age. (Contractor's abstract)

1733

Mount Zion Hospital, San Francisco, Calif.

A THERMISTOR BRAIN PROBE, by W. W. Alberts and E. W. Wright, Jr. [1960] [1]p. incl. illus. diagr. (AFOSR-1535) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)48, Harry Freund Memorial Foundation, Max C. Fleischmann Foundation of Nevada, and Office of Naval Research under Nonr-296801) Unclassified

Also published in Jour. Neurosurg., v. 18: 560, 1961.

This note describes a brain probe which may be used for simultaneous measurement of cerebral temperature and application of radiofrequency current for production of lesions. The probe is made from 19-gauge stainless steel hypodermic tubing with a rounded tip and an autoclavable electrical connector at the top end. The tip contains a thermistor bead. A single insulated wire is led up the shaft from the bead to the connector, the hypodermic tubing serves as the other thermistor lead. Temperature is read on a dc microammeter connected in a conventional bridge circuit. For production of lesions the probe is insulated with thin-walled Teflon tubing. The whole unit may be autoclaved. A 1.75 mc vacuum-tube oscillator generates the current used to heat cerebral tissue near the tip of the electrode. One side of the generator is grounded and is connected to a large indifferent electrode on the patient. The hypodermic tubing of the probe serves as the second lead for the radiofrequency as well as for the direct current from the thermistor bridge.

1734

Mount Zion Hospital, San Francisco, Calif.

SIMPLE GRAPHIC STEREOTAXIC LOCALIZATION, by W. W. Alberts. [1960] [2]p. incl. diagrs. (AFOSR-1536) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)48, Harry Freund Memorial Foundation, Max C. Fleischmann Foundation of Nevada, and Office of Naval Research under Nonr-296801) Unclassified

Also published in Jour. Neurosurg., v. 18: 561-562, 1961.

A way of locating intracranial landmarks is described. The method utilizes a Leksell stereotaxic frame with coordinate scales and a cassette at a fixed distance from the frame. Lateral films of the skull can then be taken with a roentgen-ray tube in 2 positions: 1 above and to 1 side of the patient's head, the other below and to the other side of the patient's haad. The 2 positions need not be known nor be the same distance from the patient. The distance between the stereotaxic frame and the roentgen-ray film must be constant and the film must be parallel to the frame. The actual coordinates of the commissures are then found by plotting the coordinate readings of the commissures on the coordinate scale nearest the roentgen-ray film and on the scale farthest from the film. It is then possible to determine the 3 coordinates necessary for the stereotaxic location.

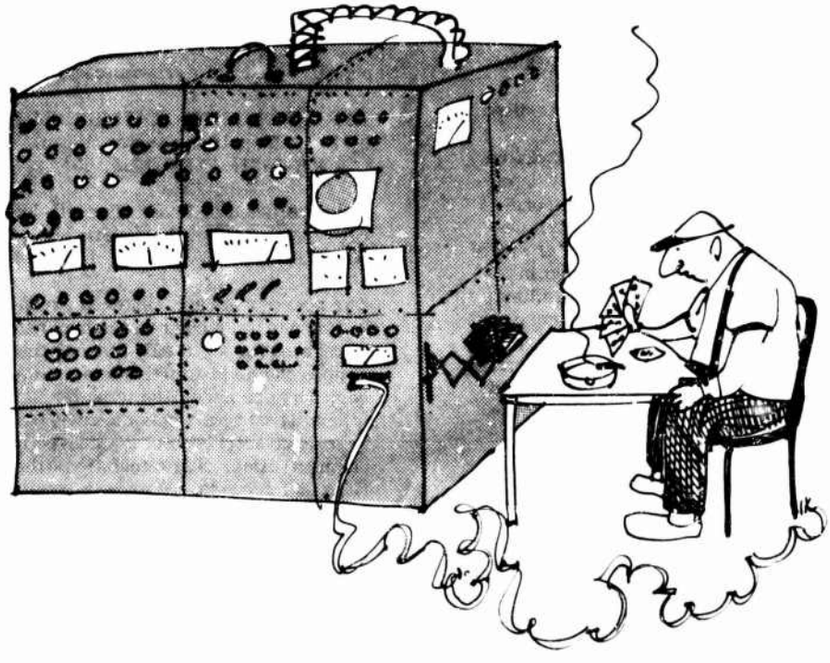
1735

Mount Zion Hospital, San Francisco, Calif.

ELECTRICAL STIMULATION OF THE HUMAN THALAMUS AND GLOBAL PALLIDUS, by W. W. Alberts, E. W. Wright, Jr. and others. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)48 and Office of Naval Research under Nonr-296801) AD 241714 Unclassified

Also published in Physiologist, v. 3, Aug. 1960.

In 3 cases of intractable pain, portions of the posterior ventral lateral and posterior ventral medial thalamic nuclei were explored by electrical stimulation prior to thermal lesion production. Brief (~ 1 sec) trains of 1-msec square pulses of alternating polarity, 60 pulses/sec, at threshold strength (0.3-2.5 ma with 2-3 mm electrode tip), elicited contralateral sensations. The generally known topographic relationships were verified (face, medial; arm, intermediate; leg, lateral). The sensations included not merely paresthesia (tingling and electric shock) but also warmth, drawing or constriction, pain, vibration, and the feeling of motion without contraction, as well as occasional contraction. Pain, when elicited, was in the area of the patient's own pain. By comparison, 146 threshold stimulations (0.5-7.5 ma with 5-10 mm electrode tip, 5-10 sec trains, other parameters as above) in 62 Parkinson patients produced mainly contralateral tremor in two lateral ventral thalamic targets (70%, 88% of responses) and in two pallidal targets (53%, 65%). Muscle contraction, sensation (but only of the paresthesia type), and other responses including cessation of tremor, nausea, apprehension, etc. were also found. (Contractor's abstract)



1736

Naples U. Inst. of Aeronautics (Italy).

TURBULENT MIXING OF STREAMS OF DIFFERENT GASES, by L. G. Napolitano. Final rept. pt. 1, July 1960 [50]p. incl. diagrs. refs. (I. A. rept. no. 18) (AFOSR-TR-60-123, Pt. 1) (AF 61(052)160) AD 252882 Unclassified

Exact solutions for constant temperature isovel, turbulent, 2 dimensional mixing of 2 infinite streams of different gases are presented. Three solutions were obtained, based on 3 different phenomenological models for the turbulent transports. The 3 different phenomenological models assumed are illustrated and discussed first. Pertinent equations are then derived and exact closed form solutions are obtained for each 1 of the 3 models considered. An analysis of the characteristics of the mixing region is carried out and the differences in the distributions of the mean properties for the different models is brought forth. The experimental tests to be performed to determine the physically more appropriate model are finally discussed. (Contractor's abstract)

1737

Naples U. Inst. of Aeronautics (Italy).

LAMINAR MIXING IN THE PRESENCE OF AXIAL PRESSURE GRADIENTS, by L. G. Napolitano and A. Pozzi. Final rept. pt. 2, Oct. 1960 [92]p. incl. diagrs. tables, refs. (I. A. rept. no. 22) (AFOSR-TR-60-123, Pt. 2) (AF 61(052)160) AD 252883 Unclassified

Incompressible, laminar plane mixing is investigated. Questions concerning the validity of a boundary-layer approach and the nature of the third boundary-condition, are settled first. Basic equations are then derived and their solution presented in the form of single quadratures for general pressure gradients and in closed form for special classes of pressure gradients. Results are analyzed and discussed with reference to the direct and indirect effects of pressure gradients on the characteristics of the mixing region. The accuracy and limits of validity of the method are evaluated and its extension to the homoenthalpic compressible case worked out. (Contractor's abstract)

1738

Naples U. [Inst. of Aeronautics] (Italy).

ON AN EXACT SOLUTION OF LAMINAR MIXING OF TWO DIFFERENT GASES, by L. G. Napolitano. [1960] [2]p. incl. diagr. (AFOSR-3719) (AF 61(052)-160) Unclassified

Also published in Jour. Aero/Space Sci., v. 27: 144-145, Feb. 1960.

An exact solution of isovel laminar mixing is obtained. Temperature profiles obtained by assuming Lewis number constant and equal to one and those obtained by this exact solution are presented and compared for the system Air-H_2, Air-CH_4, Air-CO_2. The exact solution can be extended to other geometries of interest in mixing problems and can be used when the mixing is not isovel, to devise an iteration procedure which is rapidly convergent.

1739

[Naples U. Inst. of Aeronautics (Italy)]

[ISOVEL LAMINAR MIXING OF STREAMS OF DIFFERENT GASES] Interazione laminare isotachia di correnti di gas diversi, by L. G. Napolitano. [1960] [16]p. incl. diagrs. refs. (AFOSR-3720) (AF 61(052)160) Unclassified

Also published in Missili, v. 2: 5-20, Apr. 1960.

An exact closed form solution for the isovel laminar mixing of two semiinfinite streams of different gases is presented. The exact solution is used to yield approximations introduced by the following two simplifications for dissipative motions: (1) linearization; (2) equal dissipative thickness (i.e. Lewis number equal to one for the subject case). The solution suggests a method for the experimental determinations of the functional dependence of the diffusion coefficient upon the absolute temperature.

1740

Naples U. [Inst. of Aeronautics] (Italy).

HYPERSONIC NON-EQUILIBRIUM FLOWS (Abstract), by L. G. Napolitano and A. Pozzi. [1960] [1]p. (AFOSR-3721) [AF 61(052)160] Unclassified

Also published in Proc. Eleventh Internat'l. Astronautical Congress, Stockholm (Sweden) (Aug. 15-20, 1960), Wien, Springer-Verlag, v. 1: 628, 1961.

The non-equilibrium centered expansion wave around a 2-dimensional corner in the hypersonic regime is investigated for an ideally dissociating gas obeying a simple chemical-kinetics mechanism. Two sets of solutions are presented in power series in terms of (σ) and $(1/\sigma)$ where σ is the ratio between a macroscopic time, characteristic of the convective motion, and a chemical time, characteristic of the rapidity of the chemical process. Boundary layer type phenomena occurring in the linearized process around equilibrium flow fields are analyzed, discussed, and solved. Results are applied to compute practical examples for a large and systematic variety of initial and boundary conditions in order to bring out and investigate the role played by physico-chemical parameters in the establishment and characteristics of non-equilibrium flowfields.

1741

Naples U. Inst. of Aeronautics (Italy).

[CONTRIBUTION TO THE STUDY OF FLUID

DYNAMICS OF SYSTEMS NOT IN THERMODYNAMIC EQUILIB[illegible] Contributo allo studio della fluidodinamic[illegible] istemi non in equilibrio termodinamico, by L. G[illegible]apolitano. [1959] [21]p. incl. diagrs. tables. (AFOSR-3722) (AF 61(052)160) Unclassified

Presented at Sixteenth Congresso Nazionale di Aerotecnica, Pisa (Italy), Oct. 6-10, 1959.

Also published in Aerotecnica, v. 40: 151-171, 1960.

A general study is presented of motions not in thermodynamic equilibrium with an ideal binary mixture of gas reagents when a single microscopic time characteristic of that chemical is different from zero. Three general methods of consistent solutions are developed as a limiting series of parameters for measuring the consequence of the disturbance introduced by the boundary conditions and of the rapidity of the kinetic-chemical process relative to the convective movements of the mixture. The solutions are successively applied to the analysis of the expansion around the edge. The phenomena of the limit layers occurring when the conditions of the mixture are detached from those of thermodynamic equilibrium are singled out, illustrated and discussed.

1742

[Naples U. Inst. of Theoretical Physics (Italy)]

MORPHOLOGY OF NERVE NETS, by V. Braitenberg. [1959] [11]p. incl. diagrs. [AF 61(052)96] Unclassified

Published in Nuovo Cimento, Series X, Suppl., v. 13: 521-531, 1959.

The author gives a detailed account of the nerve net basic unit, the neuron and its properties. Methods such as the golgi staining apparatus, fiber staining, analine dyes, and fiber tracing are discussed and the limitations of each pointed out. These methods have helped determine the properties of the neuron, the bundle, and the myelinated and unmyelinated sections of the nervous system which are discussed in detail. The author points out that too frequently the assumption of clear-cut findings where only hypotheses were intended has generated much confusion. The expres- $\bar{E}$ v (AB$\bar{D}$) v (AC$\bar{D}$) v (BC$\bar{D}$), a McCulloch and Pitts abstraction in Hilbert and Ackermann notation, may be a very logical expression, but its relation to neurons is very tenuous.

1743

Naples U. [Inst. of Theoretical Physics] (Italy).

[CEREBELLAR STRUCTURE AND FUNCTION], by V. Braitenberg. Annual summary rept. May 1, 1959-Apr. 30, 1960. May 28, 1960, 7p. (AFOSR-TN-60-713) [AF 61(052)96] Unclassified

The experimental interests in neuron assembly studies and the status in neurohistology, kinematography, and electrophysiological work are discussed. The following work being undertaken is summarized: how a timing mechanism in the cerebellum may be employed in the control of voluntary movements, morphological observations on the optic tectum of teleosts, attempts at a mathematical characterization of an area of undifferentiated cerebral cortex in man, and measurements on dendrites of the cerebral cortex of Bos taurus.

1744

Naples U. Inst. of Theoretical Physics (Italy).

OUTLINE OF A THEORY OF THOUGHT-PROCESSES AND THINKING MACHINES, by E. R. Caianiello. [1960] 32p. (AFOSR-1295) (AF 61(052)96) AD 262251 Unclassified

Also published in Jour. Theoretical Phys., v. 2: 204-235, 1961.

Thought-processes and certain typical mental phenomena are schematized into exact mathematical definitions, in terms of a theory which, with the assumption that learning is a slow process, reduces to 2 sets of equations: neuronic equations, with fixed coefficients, which determine the instantaneous behavior, mnemonic equations, which determine the long-term behavior of a model of the brain or thinking machine. A qualitative but rigorous discussion shows that this machine exhibits, as a necessary consequence of the theory, many properties that are typical of the living brain: including need to sleep, ability spontaneously to form new ideas (patterns) which associate old ones, self-organization towards more reliable operation, and many others. Future works will deal with the quantitative solution of these equations and with concrete problems of construction – things that appear reasonably feasible. With a transposition of names, this theory could be applied to many sorts of social or, more generally, collective problems. (Contractor's abstract)

1745

[Naples U. Inst. of Theoretical Physics (Italy)]

TOWARD A MATHEMATICAL DESCRIPTION OF THE GREY SUBSTANCE OF NERVOUS SYSTEMS, by V. Braitenberg and F. Lauria. [1960] [17]p. incl. illus. diagrs. tables, refs. [AF 61(052)96] Unclassified

Published in Nuovo Cimento, Series X, Suppl., v. 18: 149-165, 1960.

Theories are described which may explain the action of the brain. The analysis is undertaken of the complexity of the structure of nerve cell aggregates and the high degree of functional organization in them. Logical, statistical, and psychological theories are reviewed on the basis of previous investigations and observations. An attempt is made to begin the development of a scheme for the translation from physiological and anatomical data into a mathematical formalism. Examples of typical nerve nets of vertebrate brains are discussed as an illustration of possible growth and development.

1746

National Bureau of Standards, Washington, D. C.

SPECTROSCOPY OF FLUORINE FLAMES. I. HYDROGEN FLUORINE FLAME AND THE VIBRATION-ROTATION EMISSION SPECTRUM OF HF, by D. E. Mann, B. A. Thrush and others. [1960] [12]p. incl. tables, refs. [CSO-680-56-31] Unclassified

Published in Jour. Chem. Phys., v. 34: 420-431, Feb. 1961.

The hydrogen fluoride vibration - rotation emission spectrum from a hydrogen-fluorine diffusion flame has been studied from 3200 cm^{-1} in the infrared to about 5500A in the visible. Measurements were made on the rotational lines in 23 bands including (1-0), (2-1), and (3-2) of the $\Delta\nu = 1$ sequence; (2-0), (3-1), (4-2), (5-3), and (6-4) of $\Delta\nu = 2$; (3-0), (4-1), (5-2), and (6-3) of $\Delta\nu = 3$; (4-0), (5-1), (6-2), (7-3), (8-4), and (9-5) of $\Delta\nu = 4$; and (5-0), (6-1), (7-2), (8-3), and (9-4) of $\Delta\nu = 5$. Complete rotational and vibrational analyses were carried out. The constants B_ν, D_ν, and H_ν are given for $\nu = 0$ to 9. The data were extensive and precise enough to warrant an extended Dunham treatment from which 18 coefficients could be determined, including those for terms in $(\nu + 1/2)^5$ and $j^4 (j + 1)^4$. Band centers for 22 bands and the vibrational term values E_ν for $\nu = 0$ to 9 are given.

1747

National Bureau of Standards, Washington, D. C.

LOWER BOUNDS FOR EIGENVALUES WITH APPLICATION TO THE HELIUM ATOM, by N. W. Bazley. [1960] [6]p. [CSO-680-56-37] Unclassified

Published in Phys. Rev., v. 120: 144-149, Oct. 1, 1960.

A method is derived for finding lower bounds to the energy levels of the Schrödinger equation. This method is applied to the helium atom. The best lower bounds thus obtained are -3.063_7 and -2.165_5 atomic units for the energies $E(1\ ^1S)$ and $E(2\ ^1S)$, respectively. If our lower bound for $E(2\ ^1S)$ is used together with the best published values of $H\psi, \psi$ and $H\psi, H\psi$ of the ground state, a rigorous lower bound -2.9037474 atomic units is found for $E(1\ ^1S)$. (Contractor's abstract)

1748

National Bureau of Standards, Washington, D. C.

PRESERVATION OF EDGE DETAIL IN METALLOGRAPHY, by W. D. Hayes, N. J. Tighe, and H. B. Kirkpatrick. [1960] [1]p. incl. illus. diagr. (AFOSR-TN-60-19) [CSO-680-59-3] Unclassified

Also published in Metal Prog., v. 81: 112, Mar. 1962.

In studying the behavior of metals exposed to reactive atmospheres, it is usually desirable to observe microscopically the nature of the layer of reaction products formed on the surface and the interface between this layer and the metal. Numerous unsuccessful attempts to preserve reaction layers of nitrided titanium and of oxidized columbium using published techniques led to an improvement of the packmounting technique which gave superior results. This consists essentially of inserting thermoplastic film between each adjacent pair of specimens in a pack prior to mounting the assembly in a moulding plastic. One of the two principal advantages of using plastic separators is a marked reduction in size and number of voids that otherwise remain between the thin, oxidized metal specimens after pack mounting face to face. The other is that the deformability of the plastic film separators reduces the stress concentration on irregular surfaces of specimens when pressure is applied by clamping specimens together in a pack and in the subsequent molding process.

1749

National Bureau of Standards, Washington, D. C.

PRESERVATION OF EDGE DETAIL DURING METALLOGRAPHIC SECTION PREPARATION, by W. D. Hayes, N. J. Tighe, and H. B. Kirkpatrick. July 1960 [12]p. incl. illus. diagr. (NBS rept. no. 6910) (AFOSR-TN-60-48) (CSO-680-59-3) AD 243434 Unclassified

A method is described for the preparation of metallographic sections of specimens having fragile surface layers. It has been shown that the use of plastic separators between specimens, in either standard thermosetting mounts or cold setting mounts, in combination with relatively standard polishing techniques, preserves edge detail which normally would have been destroyed during preparation of specimens. In contrast with metal separators, the plastic has the advantage that its deformability provides uniform distribution of the stresses resulting from clamping and mounting, and positive elimination of nonsupported edges resulting from voids. Any deformation occurs in the plastic separators, leaving the specimen undamaged. The choice of a particular plastic sheet material is governed by the molding temperature and consideration of the solutions to which a mount will be exposed during polishing and etching. (Contractor's abstract)

1750

National Bureau of Standards, Washington, D. C.

STUDIES OF HIGH TEMPERATURE REACTIONS. I. KINETICS OF THE INITIAL OXIDATION OF NIOBIUM, by H. B. Kirkpatrick and N. J. Tighe. II. HIGH-TEMPERATURE ARC STUDIES, by J. B. Shumaker. Final rept. Dec. 1959 [75]p. incl. illus. diagrs. tables, refs. (NBS rept. no. 6964) (AFOSR-TR-60-11) (CSO-680-59-3) Unclassified

Part I. The oxidation behavior of niobium was studied in the temperature range 336°C-475°C by means of microbalance techniques. In the initial stage the

weight-gain-time data can be fitted better by a logarithmic equation than by a parabolic one. In this stage of the reaction a surface film of oxide of approximately constant thickness is formed. The transition to linear kinetics is brought on by the nucleation and growth of the γ-niobium pentoxide. This occurs in the metal phase immediately below the surface and involves the recrystallization of the solid solution of oxygen in niobium either directly to the pentoxide or into an intermediate phase which in turn oxidizes rapidly to the pentoxide. In the linear stage the reaction continues as a surface process because of the property of the niobium pentoxide layer and the large change in volume associated with its formation, which prevents the formation of a stable metal-metal oxide interface. Part II. The second part of this paper was concerned with the study of chemical reactions at unusually high temperatures. It was found that as the temperature of a gas in thermodynamic equilibrium increases from 0°K at constant pressure the concentration of particles in any given excited energy level, and consequently the intensity of all associated spectral lines, passes through a maximum. The arc source was an arc between water-cooled tungsten electrodes without mechanical constrictions, in a gas-tight water-cooled cylindrical can. This free burning arc suffered from instability, adding another difficulty to the experiment. A nitrogen-arc has been placed in operation for the continuation of this project.

1751

National Bureau of Standards, Washington, D. C.

MECHANICAL AND ELECTROMECHANICAL PROPERTIES OF INDIUM ANTIMONIDE, by R. F. Potter, J. H. Wasilik, and R. B. Flippen. [1959] [32]p. incl. diagrs. tables, refs. [CSO-680-59-6] Unclassified

Published in Mechanical Properties of Intermetallic Compounds; A Symposium, Philadelphia, Pa. (May 3-7, 1959), New York, Wiley and Sons, 1960, p. 265-296.

A comprehensive study of mechanical properties of InSb is presented with the aim of showing how such a study can contribute to the basic understanding of the physics of a material. The general topics discussed are: elastic constants and their relationship to dynamic lattice theory and to the electronic behavior; anelastic effects and their relationship to the imperfect nature of the lattice; piezoresistivity and how it demonstrates the effect lattice strains have on the electronic characteristics; and evidence of piezoelectricity.

1752

National Bureau of Standards, Washington, D. C.

DIELECTRIC CONSTANT AND DIELECTRIC LOSS OF TiO_2 (RUTILE) AT LOW FREQUENCIES, by R. A. Parker and J. H. Wasilik. [1960] [23]p. incl. diagrs. refs. (NBS rept. no. 6889) (AFOSR-TN-60-692) (CSO-680-59-6) AD 239495 Unclassified

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 202, Mar. 21, 1960. (Title varies)

Also published in Phys. Rev., v. 120: 1631-1637, Dec. 1, 1960.

Measurements have been made of the complex capacitance ($C = C' - iC''$) of undoped, high resistance, single crystal TiO_2 (rutile) in vacuum at 78, 195, 273, and 300°K as a function of frequency between 10^1 and 3×10^6 cps with a 0.1 v ac signal. With the field in the c-direction, one low frequency loss peak is found at 200 cps. The capacitance and loss of a 2 mm cube with the field in the c-direction are characterized by $\frac{1}{2\pi\tau} = 200$ sec^{-1}, $\tan\delta_{200\ cps} = 0.7$, and a dielectric constant $(\epsilon')_{1Mc/sec}$ of 170, while $(\epsilon')_{20\ cps} = 30,000$. The loss and low frequency capacitance of the crystal are directly proportional to the area of the electrodes and depend but slightly on the sample thickness, electrode materials and surface treatment. C' and C'' have been measured at 300°K as a function of the oxygen vacancy concentration in the crystal. C' and C'' have also been measured as a function of dc bias from 0 to 400 v; $(C')_{20\ cps}$, $(C'')_{max}$ and τ are proportional to V^{-n} where n is between 0.3 and 0.8. The results of the experiments can be explained by an electron-deficient barrier layer whose thickness increases with increasing applied dc voltage. When the dc voltage in the c-direction is changed, effects are observed whose time constants are of the order of hours or even days.

1753

National Bureau of Standards, Washington, D. C.

RELAXATION EFFECTS AND OTHER MECHANICAL PROPERTIES OF SOLIDS, by J. H. Wasilik. Final rept. Sept. 1960, 6p. (AFOSR-TR-60-133) (CSO-680-59-6) Unclassified

The results obtained under this contract are mainly presented elsewhere. (item nos. NBS. 39:001, Vol. II; 1752, Vol. IV; and 1751, Vol. IV). This report seeks to amplify somewhat on the experimental techniques and instrumentation, and give some thought to possibilities for future research. For the piezoelectricity in InSb investigation the sample was treated as a piezoelectric resonator, looking for acoustical resonant modes excited by alternating electric fields of the proper frequencies. It was also assumed that the contact resistance remains constant through a piezoelectric resonance. In studying the mechanical properties of rutile, it was found that the internal friction was too small to be measured by the method of composite resonators.

1754

National Bureau of Standards, Washington, D. C.

INTERMEDIATE STATE IN CYLINDRICAL SUPERCONDUCTORS (Abstract), by C. A. Shiffman. [1960] [1]p. [CSO-680-59-7] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 17-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 13, Jan. 17, 1960.

The field variation along the axis of long circular cylinders of superconductors has been measured in the presence of a transverse magnetic field of sufficient magnitude to place the specimen in the intermediate state. A bismuth micro-probe technique is used to sense the field variations and hence, the normal and superconducting domain distributions. Adequate resolution is guaranteed by the use of probes with effective dimensions of about 20μ, scanning the specimen surface at a separation of less than 20μ. The domain distribution has been measured as a function of specimen size, metallurgical state, magnetic field, and temperature mainly in the case of tin, but to some extent for alumirum. The results are discussed in terms of the various models of the intermediate state and the theories of the surface energy between normal and superconducting phases.

1755

National Bureau of Standards, Washington, D. C.

BEHAVIOR OF ISOLATED DISTURBANCES SUPERIMPOSED ON LAMINAR FLOW IN A RECTANGULAR PIPE, by G. C. Sherlin. [1960] [9]p. incl. diagrs. [CSO-680-59-7] Unclassified

Published in Jour. Research Nat'l. Bur. Stand., v. 64A: 281-289, July-Aug. 1960.

An investigation was conducted in a horizontal transparent rectangular pipe to study the behavior, in laminar flow, of an isolated turbulent-like disturbance produced by injecting a quantity of dye into the pipe 39 ft from the entrance. As the resulting mass of colored water moved downstream, time-distance measurements were made for the front of the dye mass and for the rear of the disturbance. The experimental setup, which is described in some detail, permitted reasonable control over the main flow rate from which the Reynold's number was calculated. The utilization of the data unfolded a functional relationship among three quantities: the ratio of the velocity of the rear of the disturbance to the velocity of the front of the dye U_R/U_F; the distance from the origin, X_F; and the Reynolds number R.

1756

National Bureau of Standards, Washington, D. C.

MEAN MOTIONS IN CONDITIONALLY PERIODIC SEPARABLE SYSTEMS, by J. P. Vintl. Nov. 10, 1960, 15p. incl. refs. (NBS rept. no. 6998) (AFOSR-TN-60-1254) (CSO-680-60-2) AD 246592 Unclassified

Also published in Jour. Research Nat'l. Bur. Stand., v. 65B: 131-135, Apr.-June 1961.

The following theorem is proved: in any conditionally-periodic separable system, the mean frequency of any separation coordinate is equal to the corresponding frequency. The corresponding frequency is equivalent to the partial derivative of A with respect to J, where A is the energy and J is the k-th action variable. The proof is carried out for non-singular Staeckel systems, so that it is applicable to any non-polar orbit of an artificial satellite, when the potential leads to separability. (Contractor's abstract)

1757

National Bureau of Standards, Washington, D. C.

SATELLITE FREQUENCIES WITH A NEW GRAVITATIONAL POTENTIAL (Abstract), by J. P. Vinti. [1960] [1]p. [CSO-680-60-2] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 8, Jan. 27, 1960.

A new gravitat. al potential, expressed in oblate spheroidal coordinates ξ, η, Φ, represents accurately the even-harmonic part of the earth's field and leads to quadrature solutions for satellite orbits. It therefore appears possible to find the orbital effects of oblateness without perturbation theory. If n_1, n_2, n_3 are the corresponding natural frequencies, then n_3 is the mean sidereal frequency, $1/n_2$ the mean time from ascending node to ascending node, and n_3-n_2 the mean secular rate of motion of the nodes in an inertial system. Whenever perigee is at a node, then $\xi = \xi_{min}$, so that n_2-n_1 is the mean secular rate of the line of apsides relative to the line of nodes. Series expansions of these quantities in an oblateness parameter k show first-order vanishing of $n_2 - n_1$ for a critical inclinati 63.4°, with no singularities through second order. The perturbation theories reveal the same critical inclination, with singularities at that value. The absence of singularities with the present potential is shown to arise from the special value of the fourth harmonic that it requires.

1758

National Research Council. National Academy of Sciences, Washington, D. C.

MAGNETO-FLUID DYNAMICS; PROCEEDINGS OF A SYMPOSIUM. Williamsburg, Va. and Washington, D. C., Jan. 18-23, 25, 1960, ed. by F. N. Frenkiel and W. R. Sears. Washington, National Academy of Sciences, National Research Council, 1960 [334]p. incl. illus. diagrs. tables, refs. (AFOSR-303)

(Sponsored jointly by Air Force Office of Scientific Research, International Union of Theoretical and Applied Mechanics, National Academy of Sciences, National Research Council, National Aeronautics and Space Administration, National Science Foundation, Office of Naval Research and United Nation Educational, Scientific and Cultural Organization) Unclassified

Also published in Rev. Modern Phys., v. 32: 693-1033, Oct. 1960.

This symposium represents a presentation of 54 papers emphasizing the continuum aspects of magneto-fluid dynamics. Subjects discussed included shock waves, charged particles, boundary layers, energy spectra, and fluid flow.

1759

National Research Council. National Academy of Sciences, Washington, D. C.

PENETRATION OF CHARGED PARTICLES IN MATTER; PROCEEDINGS OF AN INFORMAL CONFERENCE, Gatlinburg, Tenn., Sept. 15-18, 1958, ed. by E. A. Uehling. Washington, National Academy of Sciences, National Research Council, 1960, 174p. incl. illus. diagrs. tables, refs. (Nuclear science series rept. no. 29; National Research Council publ. no. 752) (AFOSR-1188) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and National Science Foundation) Unclassified

The Gatlinburg conference featured talks on topics ranging from the reliability of experimental data to new approaches in the theoretical description of energy loss mechanisms. In addition there were unscheduled talks and informal discussions during free intervals of the 4-day period. Sessions were held on stopping power and ranges, recent developments in the theory of stopping power, charge changing collisions, atomic and molecular scattering, ionization in gases by high-energy particles, and energy loss distributions. Separate abstracts were prepared for 22 of the 24 papers presented.

1760

National Research Council. National Academy of Sciences, Washington, D. C.

SEMICONDUCTOR NUCLEAR PARTICLE DETECTORS; PROCEEDINGS OF AN INFORMAL CONFERENCE, Asheville, N. C., Sept. 28-30, 1960, ed. by J. W. T. Dabbs and F. J. Walter. Washington, National Academy of Sciences, National Research Council, 1961, 280p. incl. illus. diagrs. tables, refs. (Nuclear Science series rept. no. 32; National Research Council publ. no. 871) (AFOSR-1189) Unclassified

Thirty-nine papers were presented at this conference. They are arranged under the topical headings of mechanisms of operation, detector configurations, applications, particle energy loss, semiconductor surfaces, materials, detection of low-energy particles, detector and amplifier noise, edge protection and stability, transient response, and recipes for detector fabrication. An extensive bibliography is included. Thirty-four of the papers presented also contain abstracts.

1761

[National Research Council]. National Academy of Sciences, Washington, D. C.

SYMPOSIUM OF PLASMA DYNAMICS, Woods Hole, Mass., June 9-13, 1958, ed. by F. H. Clauser. Reading, Addison-Wesley Publishing Co., 1960, 369p. incl. illus. diagrs. tables, refs. (AFOSR-TR-60-27) [AF 49(638)364] Unclassified

Papers and discussions from the symposium on plasma dynamics are presented. Problems in generating, heating, and confinement of plasmas are discussed. Other topics include the behavior of highly ionized plasmas, the dynamics of electron beams, explanations and applications of statistical plasma mechanics, an analysis of a plasma and its properties by continuum dynamics, and theories on solar, planetary, and interplanetary flight as well as cosmical magnetohydrodynamics.

1762

National Research Council. National Academy of Sciences, Washington, D. C.

NON-CRYSTALLINE SOLIDS; A CONFERENCE, Alfred, N. Y., Sept. 3-5, 1958, ed. by V. D. Frechette. New York, Wiley and Sons, 1960, 536p. incl. illus. diagrs. tables, refs. (AF 49(638)419) Unclassified

The conference on non-crystalline solids brought together leading investigators interested in determining the structure of non-crystalline solids, the methods capable of disclosing their structure, and the basis for finding, explaining, and deriving their properties. Twenty papers were presented covering the following topics: radiation scattering, electronic structure, relaxation phenomena, and structures and properties of special systems.

1763

National Research Council. National Academy of Sciences, Washington, D. C.

PROBLEMS RELATED TO INTERPLANETARY MATTER; PROCEEDINGS OF AN INFORMAL CONFERENCE, Highland Park, Ill., June 20-22, 1960, Washington, National Academy of Sciences, National Research Council, 1961, 105p. incl. diagrs. tables, refs. (Nuclear Science series rept. no. 33; National Research Council publ. 845) (AFOSR-721) [AF 49(638)751] Unclassified

The theme of this conference was chosen in response to the increasing interest of geoscientists in problems related to outer space. Twenty papers were presented on the topics of cosmic ray induced activity, element abundances, upper atmospheric radiation and meteorites.

1764

National Research Council. National Academy of Sciences, Washington, D. C.

PROBLEMS OF THE EVALUATION AND PROCESSING OF THE NUMERICAL DATA OF SCIENCE, by G. Waddington. Final rept. Nov. 21, 1960, 5p. (AFOSR-TN-60-1492) (AF-AFOSR-60-22) Unclassified

This contract provided partial support for a conference on the Present Status of the Evaluation and Processing of the Numerical Data of Science at New Hampshire on June 20-24, 1960. It also provided support for United States participation in establishing standards in symbolic language on an international basis. Toward this end the U. S. role in the International Standards Organization Meeting in Copenhagen, Denmark and that organization's directive to its ISO Technical Committee 12 are outlined. Another concern of this contract has been the creation of international steam tables for industrial use. The immediate plans for this project are also discussed. Finally as a result of the New Hampshire conference, the creation of a pilot plant study on machine processing of low temperature calorimetric data has gained the support of this contract and plans for this project and aims of the experiment are discussed.

1765

Nebraska U., Lincoln.

A STUDY OF THE BOUNDARY VALUE PROBLEM FOR NONLINEAR SECOND ORDER ORDINARY DIFFERENTIAL EQUATIONS, by L. Jackson. Apr. 15, 1960, 40p. incl. refs. (AFOSR-TN-60-491) (AF 49-(638)506) AD 238237; PB 148413 Unclassified

The boundary valued problem for the equation $y'' = f(x, y, y')$ is studied by subfunction methods. The first section reviews some results concerning the equation. The second section develops the properties of subfunctions and superfunctions. In the final two sections, the functions are applied to a study of the boundary value problem for the equation.

1766

New Hampshire U. Dept. of Chemistry, Durham.

ELECTROPHILIC DISPLACEMENT REACTIONS. X. GENERAL ACID CATALYSIS IN THE PROTODEBORONATION OF ARENEBORONIC ACIDS, by H. G. Kuivila and K. V. Nahabedian. [1960] [24]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1270) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)312 and Office of Naval Research) AD 248487 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 2159-2163, May 5, 1961.

The kinetics of the protodeboronation of p-methoxybenzeneboronic acid in aqueous sulfuric, phosphoric and perchloric acids, and in formic acid were studied. The rate constants in the first three acids are correlated by the acidity function H_0, but they are considerably greater at given values of H_0 in phosphoric acid than in the other two. In formic acid containing 1.3% water and 4.0% ethylene glycol dimethyl ether the rate constants are not correlated by H_0. The presence of added sodium formate in amounts which change the acidity by a factor of ten does not change the rate constant, indicating reaction with molecular formic acid. The rate of protodeboronation of the more reactive 2,6-dimethoxybenzeneboronic acid in aqueous perchloric acid up to 2.5 M is correlated by H_0, and not by stoichiometric acid concentration. In solutions containing phosphoric acid and dihydrogen phosphate the rate constants depend upon both pH and molecular phosphoric acid concentration as would be expected of a reaction subject to general acid catalysis. These results are consistent with either an A-SE2 or A-2 mechanism, but not with an A-1 mechanism. (Contractor's abstract)

1767

New Hampshire U. Dept. of Chemistry, Durham.

ELECTROPHILIC DISPLACEMENT REACTIONS. XII. SUBSTITUENT EFFECTS IN THE PROTODEBORONATION OF ARENEBORONIC ACIDS, by K. V. Nahabedian and H. G. Kuivila. [1960] [35]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1346) (AF 49(638)312) AD 248489 Unclassified

Presented at meeting of the Org. Chem. Div. of the Amer. Chem. Soc., Chicago, Ill., Sept. 7-12, 1958.

Abstract published in 134th meeting of the Amer. Chem. Soc. Abstracts of Papers, 1958, p. 37-P. (Title varies)

Also published in Jour. Amer. Chem. Soc., v. 83: 2167-2174, May 5, 1961.

Kinetic studies on the hydrolysis of nine areneboronic acids in aqueous sulfuric and phosphoric acids are described. Dependence of rate on acidity has been examined in each case, and activation parameters and solvent hydrogen isotope effects have been determined in certain cases. Conventional acidity function H_0 plots reveal the presence of two kinetically distinct regions separated by the H_0 range 5.0 to 5.5. The behavior of activation parameters and solvent isotope effects bear out this dichotomy. Consideration of these facts coupled with the effect of substituents on reactivity leads to an interpretation of the data in terms of the existence of at least two mechanisms for the reaction. (Contractor's abstract)

1768

New Hampshire U. Dept. of Chemistry, Durham.

ELECTROPHILIC DISPLACEMENT REACTIONS. XI. SOLVENT ISOTOPE EFFECTS IN THE PROTODEBORONATION OF ARENEBORONIC ACIDS, by H. G. Kuivila and K. V. Nahabedian. [1960] [13]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1347) (AF 49(638)312) AD 248488 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 2164-2166, May 5, 1961.

The effects of solvent hydrogen isotope composition (hydrogen and deuterium) on the rates of protodeboronation of p-methoxybenzeneboronic acid in 6.3 M sulfuric acid and of 2,6-dimethoxybenzeneboronic acid in 0.1 M perchloric acid have been studied. In the former case k_H/k_D is 3.7 and the rate constant variation with solvent isotope composition is nearly linear. In the latter case k_H/k_D is 1.7 and variation of rate constant with solvent isotope composition is nonlinear. This rate behavior is in quantitative accord with that expected for a rate-determining proton transfer. (Contractor's abstract)

1769

New Hampshire U. [Dept. of Physics] Durham.

INTERACTION BETWEEN COLD PLASMAS AND GUIDED ELECTROMAGNETIC WAVES, by S. J. Buchsbaum, L. Mower, and S. C. Brown. [1960] [14]p. incl. diagrs. refs. (In cooperation with Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge) (AFOSR-TN-60-561) (AF 49-(638)687) AD 249557 Unclassified

Also published in Phys. Fluids, v. 3: 806-819, Sept.-Oct. 1960.

The microwave cavity method for the measurement of various parameters of a cold plasma in the presence of a static magnetic field is examined. Emphasis is placed on the determination of the limits of validity of the perturbation theory for various mode configurations of a cylindrical cavity coaxial with a plasma column and coaxial with the static magnetic field. The classes of modes examined are those which in the absence of the magnetic field reduce to the TM_{0m0}, TM_{1mn}, TE_{1mn}, and TE_{0mn} modes. For the TM_{0m0} and TE_{0mn} modes, exact expressions for the cavity frequency shifts are obtained. These expressions are then expanded in appropriate power series to obtain the limits of validity of the perturbation method. For the TE_{0mn} modes the perturbation theory must be modified to account for the polarization of the plasma. In the absence of a magnetic field, the TM_{1mn} as well as the TE_{1mn} modes are degenerate in their resonant frequencies. The presence of a magnetic field removes the degeneracy and causes the resonant frequency to be double-valued. An experimental test of the validity of the perturbation method can be had by comparing the 2 resonant frequencies. The relation is given between the characteristics of various modes and the propagation of plane waves in infinite uniform plasmas. (Contractor's abstract)

1770

New Hampshire U. [Dept. of Physics] Durham.

INTERACTION OF A BOUNDED MICROWAVE FIELD WITH A COLD PLASMA IN A MAGNETIC FIELD (Abstract), by S. J. Buchsbaum, L. Mower, and S. C. Brown. [1960] [1]p. (In cooperation with Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge) [AF 49(638)687] Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 382, June 15, 1960.

A cylindrical plasma column is introduced coaxially into a cylindrical microwave cavity which resonates in the TE_{011} mode. An axial, static magnetic field is present. It will be shown that the interaction between the plasma column and the microwave field of the TE_{011} mode can be described, in almost all respects, by the propagation characteristics of the extraordinary plane wave (electric field and the direction of propagation both at right angles to the static magnetic field) in an infinite uniform plasma. Results of exact calculations which support this view will be presented.

1771

New Mexico U., Albuquerque.

MODELS, MEANING AND THEORIES, by M. Brodbeck. [1957] [28]p. (In cooperation with Minnesota U., Minneapolis) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)33 and Social Science Research Council) Unclassified

Published in Symposium on Sociological Theory, Evanston, Ill., Row, Peterson and Co., 1959, p. 373-403.

Also published in First Interdisciplinary Conf. on Decisions, Values and Groups, New Mexico U., Albuquerque (June-Aug. 1957), New York, Pergamon Press, v. 1: 9-36, 1960.

This paper starts by establishing the criteria for a model by using common models such as model trains and pointing out their properties. From these the author shows how models can be used in mathematics and what difficulties are circumvented by their use. Three meanings of mathematical model are explained: a quantified empirical theory, an arithmetical representation, and a formalization. These three represent respectively any theory whose descriptive terms have numbers attached to them, a set of analytic or tautological truths about numbers, and a system of considering a theory formally by laying bare the form of its axioms by replacing all the descriptive terms by letters. Finally the author demonstrates how the term model is used in physics.

1772

New Mexico U., Albuquerque.

BEHAVIOR IN GROUPS: THE DEVELOPMENT OF A SCALE TO MEASURE INDIVIDUAL PROMINENCE, by M. E. Shaw. [1957] [12]p. incl. tables. (In cooperation with Massachusetts Inst. of Tech., Cambridge) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)33 and National Science Foundation) Unclassified

Published in First Interdisciplinary Conf. on Decisions, Values and Groups, New Mexico U., Albuquerque (June-Aug. 1957), New York, Pergamon Press, v. 1: 229-240, 1960.

An analysis of individual performance within the group is presented based on three major classes defined as the variables in this study of group behavior: (1) the nature of the task the group must perform, (2) the structure of the group, (3) the kinds of individuals who compose the group. The factors which account for the variance among the ratings of individuals in the group were defined as individual prominence, group goal facilitation, and group sociability. An IP scale, consisting of eighteen items, was established to measure authoritarianism, aggressiveness, confidence, leadership, and striving for recognition. The purpose of this study is to test the reliability of this scale by comparing its results with the actual performance of the individuals in the group. The reliability and validity of the test proved satisfactory. A chi square test showed that the results could be expected by change less than one in a thousand. Thus the scale should be a useful instrument for studying the effects of individually prominent behavior upon productivity, efficiency, and satisfaction in small groups.

1773

New Mexico U., Albuquerque.

THE INFLUENCE OF PROPAGANDA WITHOUT SOCIAL SUPPORT, by M. Brodbeck. [1957] [5]p. incl. tables. (In cooperation with Minnesota U., Minneapolis) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)33 and Social Science Research Council) Unclassified

Published in First Interdisciplinary Conf. on Decisions, Values and Groups, New Mexico U., Albuquerque (June-Aug. 1957), New York, Pergamon Press, v. 1: 241-245, 1960.

An earlier study had shown that individuals who have become less confident in their opinions as a consequence of exposure to counter-propaganda, and who indicate a need for social support, tend to recover their initial confidence after participating in group discussions of both sides of the issue. This experiment was designed to test the effect of the discussions by replicating the previous experiment, but replacing the discussion period with an equal period during which the subjects silently made written comments on their views. The hypothesis was that, due to lack of social support, these subjects would tend to retain the influence of the propaganda and not recover their initial confidence. The data support the hypothesis. (Contractor's abstract)

1774

New Mexico U., Albuquerque.

HOSTILITY: THEORY AND EXPERIMENTAL INVESTIGATION, by P. Worchel. [1957] [13]p. incl. refs. (In cooperation with Texas U., Austin) [AF 49(638)33] Unclassified

Published in First Interdisciplinary Conf. on Decisions, Values and Groups, New Mexico U., Albuquerque (June-Aug., 1957), New York, Pergamon Press, v. 1: 254-266, 1960.

The purpose of this paper is to describe a drive-theory of hostility, present a series of studies designed to test several implications of this theory, and relate self-theory to the susceptibility of arousal and management of the hostile response. The results show that under the no-name condition, subjects in general expressed greater negative feelings towards the instigator than under the name condition, thus confirming the hypothesis concerning the inhibition of agression under fear of punishment. Subjects with low self-ideal discrepancy expressed significantly greater aggression towards the instigator than those with high self-ideal discrepancy. There was no significant difference between the sexes in their expression of direct aggression following frustration. There was no evidence for displacement of hostility towards instructors under any of the conditions in the experiment, thus negating the prediction from frustration-aggression theory.

1775

New Mexico U., Albuquerque.

THE ENGLISH RECORD OF A NATURAL SOCIOLOGY, by E. Rose. [1960] [23]p. incl. tables. (AFOSR-4978) (In cooperation with Colorado U., Boulder) [AF 49-(638)33] Unclassified

Also published in Second Interdisciplinary Conf. on Decisions, Values and Groups, New Mexico U., Albuquerque (June-Aug. 1958), New York, Pergamon Press, v. 2: 131-153, 1962.

Also published in Amer. Sociol. Rev., v. 25: 193-207, Apr. 1960.

It is pointed out that the meanings of words constitute uniformities of culture and that the history of the meanings of words can indicate much of the relative stability and variability of cultural forms. This paper and another (NEU. 01:021, Vol. II) trace the natural or folk sociological concepts of the English and the development of cultural concensus among Americans. Two arguments are proposed for questions about populations of notions as yet unsampled. They read in part as follows: (1) The classification by general topic of

notions that can be identified as the meanings of words in any language will appear in constant proportions throughout the whole history of that language, regardless of linguistic changes of any sort or changes in the civilization with which the meanings are associated. (2) In every semantic order found with any language, the rate of acceptance of proposals of all new ideas will vary inversely, and the rate of survival of all acceptances will vary directly with the passage of time to any point in history.

1776

New Mexico U., Albuquerque.

THE CORTICAL DESTRUCTION NECESSARY TO PRODUCE A TRANSFER OF A FORCED-PRACTICE FUNCTION, by G. M. Peterson and P. E. Barnett. [1960] [4]p. incl. diagr. tables. (AFOSR-1641) (AF 49(638)501) Unclassified

Also published in Jour. Compar. and Physiol. Psychol. v. 54: 382-385, Aug. 1961.

Forty-one rats were forced to reach with their originally nonpreferred hand until this forcing resulted in a transfer of handedness preference. Animals were then subjected to cortical lesions in the contralateral hemisphere. It was found, as hypothesized, that if the animals demonstrated a retransfer to the originally preferred hand following the operation, the destructions would localize this forced-practice function in the same sense that destructions producing transfers localize natural handedness. The region between cortex Layers IV and VI, and probably Layer V, where the cells contributing fibers to the pyramidal tract are to be found, is critical for the control of handedness in forced practice cases as well as in natural handedness.

1777

New Mexico U. [Dept. of Physics] Albuquerque.

INTERACTIONS OF EXTENSIVE AIR SHOWERS OF THE COSMIC RADIATION IN WATER (Abstract), by J. R. Green, R. Thomas, and J. R. Barcus. [1960] [1]p. [AF 49(638)34] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 23, Jan. 27, 1960.

Two scintillators, each 10 ft in diam, form a vertical telescope with an 11-ft separation. Provision is made for a variable amount of absorber between the 2 scintillators of up to 5 ft of water. Spectra are obtained for the number of particles observed in the lower scintillator as a function of various ranges or particle numbers in the upper scintillator. Preliminary results indicate that the larger air showers are not fully developed at an atmospheric depth of 840 g/cm^2. Details of the spectra will be shown.

1778

New York U., N. Y.

REACTIONS OF ORGANOMETALLIC COMPOUNDS (Abstract), by Y. A. Tajima and C. J. Marsel. [1960] [1]p. (AF 49(638)173) Unclassified

Presented at First AFOSR Contractor's meeting on Chemical Kinetics of Propulsion, General Dynamics Corp., General Atomic Div., San Diego, Calif., Sept. 6-7, 1960. (AFOSR-TN-60-1063; AD 246174)

The vapor phase pyrolysis of aluminum triethyl is studied. The thermal decomposition reactions are homogeneous with the following rate constants: $k_1 = 7.64 \times 10^{-4}$, $k_3 = 10.9$, $k_5 = 4.8 \times 10^{-4}$, $k_7 = 8.8 \times 10^{-4}$, and $k_9/k_2 = 0.171$. The main products are hydrogen, butenes, ethylene, and aluminum.

1779

New York U. [Coll. of Engineering] N. Y.

ATTEMPTS AT DERIVATION OF TRANSITION FROM LAMINAR INTO TURBULENT FLOW ALONG A FLAT PLATE, by H. F. Ludloff, D. F. De Santo, and R. Parthasarathy. Progress rept. Jan. 1960, 36p. incl. diagrs. refs. (AFOSR-TN-60-105) (AF 18(603)25) Unclassified

Progress is described for the derivation of laminar to turbulent boundary-layer transition by numerical solution of the 2-dimensional equations of motion of a viscous incompressible fluid. Derivations of the complete equations for initial perturbation quantities and for steady state quantities are presented. The completion of all programming for the numerical computation of transition behavior is noted, and the procedures which have been used to check the program are stated. The determination of the best value of an overrelaxation parameter, which has been carried out in order to make feasible the solution for perturbation stream function in each time cycle, is then described. Progress made in the actual calculation of transition behavior is described. An appendix is also included, giving findings from a theoretical approach to the present problem which was undertaken concurrently with the numerical work. (Contractor's abstract)

1780

New York U. Coll. of Engineering, N. Y.

ATTEMPTS AT DERIVATION OF TRANSITION FROM LAMINAR INTO TURBULENT FLOW ALONG A FLAT PLATE, by H. F. Ludloff and D. F. De Santo. Final rept. Nov. 1960, 42p. incl. diagrs. table, refs. (AFOSR-722) (AF 18(603)25) AD 257566 Unclassified

The derivation of a numerical scheme is described for the solution of the complete Navier-Stokes equations for 2-dimensional time-dependent viscous

incompressible flow, as applied to the problem of the development of turbulence in the laminar boundary layer on a flat plate. The basic equations are reduced to a single quasi-linear vorticity-transport equation plus a Poisson equation; these are then written in finite-difference form. The solution of the difference system comprises a semi-implicit scheme for the quasi-linear equation together with an extrapolated line-Liebmann iteration method for the linear Poisson analog. Solutions for both very low amplitude linear and very high amplitude nonlinear cases are presented and discussed. The numerical scheme is demonstrated to be stable and capable of generating solutions which exhibit major theoretical and/or experimentally-observable features for each of the 2 cases. (Contractor's abstract)

1781

New York U. Dept. of Chemistry, N. Y.

REACTION KINETICS, THERMODYNAMICS, AND TRANSPORT PROPERTIES IN THE OZONE-OXYGEN SYSTEM. A SURVEY OF PROPERTIES FOR FLAME STUDIES, by E. S. Campbell and C. Nudelman. [1960] 105p. incl. diagrs. tables, refs. (AFOSR-TN-60-592) (AF 49(638)169) AD 242327; PB 147913 Unclassified

Flame theory and experimental techniques are advancing to the point where direct comparison of theory and experiment should be possible. The best available data are collected for 1 of the simplest possible flames and its limitations are pointed out. Theoretical calculations on flames using presently available data are important primarily as mathematical experiments, to discover the significance of various physical processes within the flame. More precise experimental studies of high temperature kinetic and transport processes should be made as a basis for the necessary detailed comparison of theory with experiment. (Contractor's abstract)

1782

New York U. [Dept. of Chemistry] N. Y.

A METHOD FOR INTEGRATING A SET OF SIMULTANEOUS ORDINARY DIFFERENTIAL EQUATIONS SUBJECT TO A TYPE OF NUMERICAL INDETERMINACY, by E. S. Campbell and L. W. Schalit. [1960] [13]p. (AFOSR-TN-60-699) (AF 49(638)169) AD 295637 Unclassified

A method is proposed for the numerical integration of a system of first order ordinary differential equations containing at least 1 equation subject to numerical indeterminacy. This method overcomes the indeterminacy by integrating a related sequence of equation systems. The new method may prove useful when: (1) the equations of the system are coupled in an appropriate fashion; (2) ordinary point-by-point procedures fail due to subtraction which makes the analytic formulae for the derivatives of 1 or more variables numerically indeterminate. It has 2 advantages: (1) it offers a far more accurate initial approximation which may eliminate the necessity for iteration; (2) it will integrate equation systems for which a previous procedure (Math. Tables and Aids to Comput., v. 11: 229-233, 1957) either converges slowly or diverges. The technique is suitable for machine use. On an IBM 653 it has developed solutions for sets of 3 and 4 simultaneous nonlinear differential equations which describe a hypothetical 1-dimensional free-radical flame. (Contractor's abstract)

1783

New York U. [Dept. of Chemistry] N. Y.

NUMERICAL CONSTRUCTION OF TAYLOR SERIES APPROXIMATIONS FOR A SET OF SIMULTANEOUS FIRST ORDER DIFFERENTIAL EQUATIONS, by E. S. Campbell, R. Buehler and others. [1960] [11]p. (AFOSR-421) (In cooperation with Wisconsin U. Naval Research Lab., Madison) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-169 and Naval Bureau of Ordnance under Nord-15884) Unclassified

Also published in Jour. Assoc. Comput. Mach., v. 8: 374-383, July 1961.

An explicit procedure is described for finding the coefficients in the Taylor expansions of the solutions of simultaneous first-order ordinary differential equations. The procedure is restricted only to moderately general functional forms which occur frequently in applications. A special case is included in which the functional forms are indeterminate at the initial point. This singular case arises with the hydrodynamic equations for free-radical flames. The corresponding computer program needs subroutines for solving systems of linear equations, and for finding eigenvalues of a general matrix. The procedure has been used to find 20 to 30 terms in the solutions of 3 to 7 simultaneous hydrodynamic equations.

1784

New York U. [Dept. of Chemistry] N. Y.

ROLE OF REACTION KINETICS IN STEADY-STATE LAMINAR FLAMES (Abstract), by E. S. Campbell. [1960] [1]p. (AF 49(638)169) Unclassified

Presented at First AFOSR Contractor's meeting on Chemical Kinetics of Propulsion, General Dynamics Corp., General Atomic Div., San Diego, Calif., Sept. 6-7, 1960. (AFOSR-TN-60-1063; AD 246174)

The goals of this research include the development of mathematical techniques useful in studying the hydrodynamic equations for 1-dimensional, steady-state flames and the application of these procedures to the numerical integration of the flame equations to ascertain the effect of a qualitative change in reaction mechanism and quantitative changes in parameters for the specific rates and the transport coefficients. In addition, a qualitative interpretation of the role of the 2 eigenvalues in a 2-eigenvalue flame is investigated. The total mass-flow rate determines the cold boundary fractional mass-flow rate for the fuel gas; the second

eigenvalue controls the ratio of the rate of free radical production to its derivative in the neighborhood of the hot boundary.

1785

New York U. Dept. of Electrical Engineering, N. Y.

ENERGY RELATIONS IN FEEDBACK CONTROL SYSTEMS CONTAINING A NON-LINEAR ELEMENT, by R. Wolfson. Jan. 1960, 40p. incl. diagrs. (Technical rept. no. 400-7) (AFOSR-TN-60-17) (AF 49(638)586) AD 232433; PB 147337 Unclassified

A complete set of equations among the average output powers in a single-loop, non-linear feedback control system are developed. These energy distribution equations have a form that relates summations of output power at all frequencies in the non-linear network, to circuit responses calculated at the source frequencies. The feedback control system with the non-linear element in the forward transmission path is considered. A general set of equations with a linear network in the feedback path is presented. Energy distribution equations are also derived for a specific linear network with a $\frac{k}{s}$ (integration) transfer function. The use of these equations in the design of a feedback modulator is then illustrated. The final equations are then compared with the corresponding equations of a 2-terminal reactive modulator. (Contractor's abstract)

1786

New York U. Dept. of Electrical Engineering, N. Y.

SAMPLED-DATA CONTROL SYSTEMS WITH TWO DIGITAL PROCESSING UNITS, by J. C. Hung. Jan. 1960 [26]p. incl. diagrs. (Technical rept. no. 400-2) (AFOSR-TN-60-18) (AF 49(638)586) AD 232461; PB 146714 Unclassified

Presented at AIEE summer general meeting, Atlantic City, N. J., June 19-24, 1960.

Also published in Trans. Amer. Inst. Elec. Engineers, v. 79 (Pt. II): 292-298, Sept. 1960.

The theory and procedure for designing sampled-data control systems of the ripppleless type are presented. These systems have a digital processing unit in the forward line and another digital processing unit in the feedback loop to respond optimally to inputs as well as to neutralize the disturbance. By disturbance is meant a disturbance of step, ramp, or constant acceleration type. Two examples using the proposed design procedure are given, and their root loci are plotted and discussed. (Contractor's abstract)

1787

New York U. Dept. of Electrical Engineering, N. Y

A REGENERATIVE NON-LINEAR FEEDBACK SYSTEM, by P. E. Fleischer. May 1960 [25]p. incl. diagrs. (Technical rept. no. 400-10) (AFOSR-TN-60-433) (AF 49(638)586) AD 239439; PB 148944 Unclassified

A feedback system proposed for reducing the effect of a non-linear plant on system performance is investigated. The feedback system operates by comparing the actual output with the desired system output (internally generated) and using this difference as an actuating signal. It is shown that the arrangement, while of novel configuration, is completely equivalent to a single loop feedback system. A typical system is investigated to provide an illustration of the conclusions drawn from this study. (Contractor's abstract)

1788

New York U. Dept. of Electrical Engineering, N. Y.

OPTIMUM TRANSMISSION OF CONTINUOUS SIGNAL OVER A SAMPLED DATA LINK, by S. S. L. Chang. June 1960 [11]p. incl. diagrs. (Technical rept. no. 400-11) (AFOSR-TN-60-492) (AF 49(638)586) AD 239440; PB 148945 Unclassified

Also published in Trans. Amer. Inst. Elec. Engineers, v. 79: 538-542, Jan. 1961.

A method for simultaneous optimization of the presampling filter F(s) and post-sampling filter G(s) in a sampled data link is derived together with an equation for evaluating the mean-square error. An illustration is given by applying the method to a typical design problem. The method is used to optimize a one-way sampled data link. Applications are projected for assisting the design of a sampled-data feedback-control system with simultaneously optimized prefilter, digital processing unit, and wave shaping filter.

1789

New York U. Dept. of Electrical Engineering, N. Y.

CONTROL SYSTEM WITH MINIMUM SPECTRAL BANDWIDTH OF PLANT INPUT, by J. C. Hung. May 1960 [20]p. incl. diagrs. (Technical rept. no. 400-9) (AFOSR-TN-60-493) (AF 49(638)586) AD 239438; PB 148943 Unclassified

Also published in I. R. E. Trans. on Automatic Control, v. AC-6: 49-53, Feb. 1961.

A design method for control systems that minimizes the spectral bandwidth of the plant input signal is discussed. The plant input signal is minimized subject to the constraint that the integral square error for deterministic inputs or the mean square error for random inputs be limited to a known desired value. The control system transfer function that satisfies these requirements is derived, and the functions used in bandwidth shaping are discussed. An example of a system design using this technique is given. (Contractor's abstract)

1790

New York U. Dept. of Electrical Engineering, N. Y.

KINETIC LYAPUNOV FUNCTION FOR STABILITY ANALYSIS OF NONLINEAR CONTROL SYSTEMS, by S. S. L. Chang. [1960] [4]p. incl. diagr. (AFOSR-TN-60-560) (AF 49(638)586) Unclassified

Presented at the Joint Automatic Control Conf., Cambridge, Mass., Sept. 7-9, 1960.

Also published in Jour. Basic Engineering, v. 83: 91-94, Mar. 1961.

Kinetic Lyapunov functions are essentially a subclass of Lyapunov functions. Their use leads naturally to linearization and a sufficient condition for uniform asymptotic stability which condition is independent of the steady-state equilibrium point for a class of nonlinear control systems. The existence of a kinetic Lyapunov function is usually too strong a condition for uniform asymptotic stability in the large, but it is good whenever it can be found. (Contractor's abstract)

1791

New York U. Dept. of Electrical Engineering, N. Y.

DIGITIZED MAXIMUM PRINCIPLE, by S. S. L. Chang. July 1960, 7p. (Technical rept. no. 400-14) (AFOSR-TN-60-600) (AF 49(638)586) AD 245996, PB 153034 Unclassified

Also published in Proc. Inst. Radio Engineers, v. 48: 2030-2031, Dec. 1960.

A digital version of the maximum principle for minimal time or maximal range control of nonlinear continuous systems is stated and derived. The digitized maximum principle offers a computation process which is simple, straightforward and exact. The only error is the computer round-off error.

1792

New York U. Dept. of Electrical Engineering, N. Y.

OPTIMUM DESIGN OF PASSIVE-ADAPTIVE LINEAR FEEDBACK SYSTEMS WITH VARYING PLANTS, by P. E. Fleischer. Aug. 1960 [13]p. incl. diagrs. refs. (Technical rept. no. 400-16) (AFOSR-TN-60-748) (AF 49(638)586) AD 245997; PB 153035 Unclassified

Presented at Joint Automatic Control Conf., Cambridge, Mass., Sept. 7-9, 1960.

Also published in I. R. E. Trans. on Automatic Control, v. AC-7: 117-128, Mar. 1962.

In designing a feedback control system involving a variable (or incomplete known) plant the prime consideration, besides obtaining a satisfactory transfer function, is to specify a system which is insensitive to plant variations. Some procedures for obtaining insensitive designs are described in the literature, but they all result in systems having large open loop bandwidths. In the presence of instrument noise such systems would tend to produce an excessive noise output. A minimization is carried out, where the conflicting requirements of small sensitivity to plant variations and insensitivity to instrument noise are satisfied simultaneously. The solution is approximate, but can be justified in most physical situations. A method for iterating the solution is described. (Contractor's abstract)

1793

New York U. Dept. of Electrical Engineering, N. Y.

SHANNON'S THEORY AND FEEDBACK SYSTEMS, by S. S. L. Chang. [1959] [8]p. incl. diagrs. refs. (AFOSR-3435) (AF 49(638)586) AD 612332 Unclassified

Presented at Instruments and Regulators Conf., Cleveland, Ohio, Mar. 29-Apr. 2, 1959.

Also published in Jour. Basic Eng., v. 82: 46-50, Mar. 1960.

Feedback can be used as a means of realizing Shannon's predicted errorless capacity of a noisy communication channel. On the other hand, Shannon's information theory can be used as a guide for rating feedback control systems as well as selecting system components. A brief summary of the former aspect, and the results from some preliminary investigations of the latter aspect are presented. Included topics are calculations of required information capacities of control systems from input characteristics and fidelity requirements, required information capacities of system components and calculation of information capacities of system components from saturation limits, threshold levels, and transfer functions.

1794

[New York U. Dept. of Sociology, N. Y.]

THE MAKE A SENTENCE TEST (MAST): A REPLICATION STUDY, by E. F. Borgatta. [1961] [24]p. incl. tables. (AFOSR-TN-60-46) (AF 49(638)195) Unclassified

Also published in Jour. Gen. Psychol., v. 65: 269-292, 1961.

The relationships of MAST scores to factorially based personality inventory scores are systematically reported for samples of male and female prisoners and mental patients. Profile differences are discussed. Substantial relationship is found to the Cattell 16 Personality Factors Test, the Edwards Personal Preference Schedule, and the Guilford-Zimmerman Temperament Schedule; consistency with prior results using college and other samples is marked.

1795

[New York U. Dept. of Sociology, N. Y.]

A SYSTEMATIC STUDY OF INTERACTION PROCESS SCORES, PEER AND SELF-ASSESSMENTS, PERSONALITY AND OTHER VARIABLES, by E. F. Borgatta. [1960] [79]p. incl. tables, refs. (AFOSR-TN-60-523) (AF 49(638)195) Unclassified

Also published in Genet. Psychol. Monographs, v. 65: 219-291, May 1962.

Questions are raised concerning the strategy of design of measures for the description of persons. Ways in which individuals may be viewed are briefly outlined, and a distinction between self-reports and external observers is emphasized. A detailed analysis of a revised scoring category system is presented and analyzed systematically along with other measures, including peer and self-assessments, and personality inventory subtests. A direct relationship between peer assessments and interaction process scores (IPS) is demonstrable, particularly with regard to a content identified in the IPS's activity rate and in the peer assessments as Assertiveness. The personality inventory data appear to be primarily related to self-assessments in factor analysis.

1796

[New York U. Dept. of Sociology, N. Y.]

ROLE-PLAYING SPECIFICATION, PERSONALITY, AND PERFORMANCE, by E. F. Borgatta. [1961] [16]p. incl. tables. (AFOSR-TN-60-682) (AF 49(638)195) Unclassified

Also published in Sociometry, v. 24: 218-233, Sept. 1961.

Persons of known personality characteristics were asked to play assigned roles that involve characteristics designed to be (a) similar and (b) different from their own. Data is presented on regularities associated with differences of personality characteristics, with differences of assigned role specifications, and also with the congruency between the previously measured personality characteristics and the assigned role specifications. Emphasis is placed on the specific personality measures used in the study. The effects that are observed are described through interaction process scores and through assessments, made immediately after each role playing situation, on how well each person played and how much each person enjoyed the assigned role. (Contractor's abstract)

1797

New York U. [Dept. of Sociology] N. Y.

THE VARIABLES AND CONDITIONS OF SMALL GROUP INTERACTION, by E. F. Borgatta. Final rept. Sept. 1, 1957 - Oct. 8, 1960. [1960] 16p. incl. refs. (AFOSR-TR-60-165) (AF 49(638)195) AD 248453; PB 153080 Unclassified

This project explores the scope and inclusiveness of variables relevant to the understanding of individual and group behavior in small group interaction. Brief summaries are given of studies bearing on the description of individual behavior, the exploration of additional aspects of personality, the inducibility of changes in personality, and the structure variables in small groups.

1798

New York U. Inst. of Mathematical Sciences, N. Y.

ON POSITIVE EIGENVECTORS OF POSITIVE INFINITE MATRICES, by T. Kato. [1958] [14]p. incl. refs. (AF 18(600)367) Unclassified

Published in Commun. Pure and Appl. Math., v. 11: 573-586, Nov. 1958.

According to a classical theorem of Perron and Frobenius a finite positive matrix A has a positive dominant eigenvalue and a positive corresponding eigenvector. Infinite matrices from this point of view having the special structure $A = B - C$, where C is a small perturbation are investigated. The elements of B are given by $b_{ik} = f(i + \Theta, k + \Theta)$, $\Theta > 0$, f being a function of two independent variables restricted by some conditions. The most interesting result of the paper may be stated as follows. There are real numbers Θ_0, ω such that for $\Theta \geq \Theta_0$ every $\lambda > \omega$ is an eigenvalue of A and the associated eigenvector can be chosen positive if A is positive. The Hilbert matrix $b_{ik} = (i + k + 2\Theta)^{-1}$ is a special case of the adopted type of matrices. As an application of his general theorems the author reestablishes a result of M. Rosenblum (Proc. Amer. Math. Soc., v. 9: 137-140, 1958) concerning the Hilbert matrix. (Math. Rev. abstract)

1799

New York U. Inst. of Mathematical Sciences, N. Y.

THE FUNCTIONAL SYNTHESIS OF LINEAR PLOTS, by R. F. Dressler and J. P. Vinti. Dec. 1959, 10p. (Rept. no. IMM-NYU 264) (AFOSR-TN-60-40) (AF 49-(638)161) AD 234919 Unclassified

In practical engineering or experimental work a function F of many variables is often encountered, F(x's, y's, z's), represented only by the families of curves obtained by plotting F against each of the x's on Cartesian graph paper, against each of the y's on semi-log paper, and against each of the z's on double-log paper. Frequently these curves are all approximately straight lines over some limited range of interest. On the assumption that they are all true straight lines, it is shown how to synthesize all the graphical representations for any number of parameters into the most general formula possible, expressing F as the product of a general multilinear function of the x's and the exponential of a constant-free multilinear function of the y's and of the log z's, with the coefficients in both multilinear functions being independent of the x's, y's, and z's.

1800

New York U. Inst. of Mathematical Sciences, N. Y.

THE BUCKLING OF A THICK CIRCULAR PLATE USING A NON-LINEAR THEORY, by C. B. Sensenig. Dec. 1959, 18p. incl. diagrs. (Rept. no. IMM-NYU 262) (AFOSR-TN-60-41) (AF 49(838)181) AD 233388; PB 146748 Unclassified

The stability of equilibrium of an isotropic circular cylinder when compressed along its curved lateral surface is studied. The compression on the curved part of the boundary is such that the generators of the cylinder remain vertical straight lines with no shear stress developed. The plane faces are free of stress. A very simple state of strain, i.e., uniform plane strain, satisfies all conditions of the exact non-linear theory. Critical pressures and buckling modes are found in the instance of the introduction of a small perturbation. The buckled modes and pressures with symmetry about the axis of the cylinder are the same as those furnished by the classical thin plate theory in the limit case of small thickness of the cylinder.

1801

New York U. Inst. of Mathematical Sciences, N. Y.

REDUCTION OF STRESS CONCENTRATIONS IN PERFORATED PLATES, by E. F. Low, Jr. and I. G. Tadjbakhsh. July 11, 1960 [18]p. (AFOSR-TN-80-832) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)161 and Office of Naval Research under Nonr-28542) Unclassified

The problem of reducing stress concentrations in circularly perforated plates under uniform tension was investigated by a perturbation method. By this method it is possible to determine the shape of the boundary which reduces the maximum tensile and compressive stresses occurring at the boundary. In one example each of these stresses is reduced by 11% and 13%, respectively while the shape of the hole varies by not more than 6% from a circle. In another example the radius of the hole varied by about 10% producing a reduction of 18% in maximum tensile strength; the reduction is about 50% better than that obtained by making the hole slightly elliptical with the same 10% variation in radius. Thus both compressive and tensile stress concentrations can be appreciably reduced by slightly altering the shape of the hole.

1802

New York U. Inst. of Mathematical Sciences, N. Y.

ON THE THEORY OF PLANE STRESS, by E. L. Reiss and S. Locke. [1960] [9]p. (AFOSR-TN-80-1453) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(838)161 and Atomic Energy Commission under AT(30-1)1480) Unclassified

Also published in Quart. Appl. Math., v. 19: 195-203, Oct. 1961.

The relationship is developed between the classical theory of plane stress concerned with a thin elastic plate subjected to edge forces which deform it and the solutions found by assuming only two boundary conditions which are functions of one variable along the edge as compared to three conditions as functions of two variables. The method is to expand each stress component in a power series in the plate thickness, h. Substituting these expansions into the exact theory and equating coefficients of like powers of h yield a sequence of systems of differential equations to determine the expansion coefficients. A second expansion in h, the coefficients of which are now functions of new independent variables, produces boundary value problems, whose solutions yield approximations to the stress distribution near the edge.

1803

New York U. Inst. of Mathematical Sciences, N. Y.

PLANE STRAIN PROBLEMS FOR A PERFECTLY ELASTIC MATERIAL OF HARMONIC TYPE, by F. John. [1959] [58]p. incl. diagr. refs. (AFOSR-2463) (AF 49(638)181) Unclassified

Also published in Commun. Pure and Appl. Math., v. 13: 239-296, May 1980.

This paper is concerned with finite, plane strain deformation of a material with a particular kind of strain energy function. The positional coordinates, u(x, y), v(x, y), of particles in the strained state are taken as independent variables and the strain energy density W is considered as a function of the 2 arguments $r = [(u_x + v_y)^2 + (v_x - u_y)^2]^{1/2}$ = $s = u_x v_y - u_y v_x$. The material is defined as "harmonic" when $W(r, s) = 2\mu[F(r) - s]$; equilibrium problems in this medium may be discussed as a type of potential problem. The equations of motion are hyperbolic for $F'(r) > 0$ only, and other cases are not considered in detail. A proper solution is defined as requiring u and v to have bounded Dirichlet integrals over the bounded simply-connected region occupied by the medium, and the existence of such solutions under 2 kinds of boundary conditions is proved. For prescribed boundary displacement, uniqueness is proved. The second problem concerns a quadrilateral with 2 opposite sides straight and parallel, the other 2 arbitrarily curved and traction-free. The straight sides are brought closer together, remaining parallel and shear-free. Buckling, which is fully discussed, may exclude a unique solution. This paper is a valuable contribution to the theory of large elastic deformations.

1804

New York U. Inst. of Mathematical Sciences, N. Y.

NON-LINEAR DEFLECTION OF THIN ELASTIC PLATES UNDER TENSION, by P. Fife. [1960] [32]p. incl. refs. (AFOSR-2484) (AF 49(838)181) Unclassified

Also published in Commun. Pure and Appl. Math., v. 14: 81-112, May 1961.

The stress and deflection of a thin elastic plate of arbitrary shape subjected to a uniform tension at the edges and arbitrary normal load are investigated. Von Kármán's nonlinear equations are put into the following form:

$$\left.\begin{aligned} \Delta^2 F &= N_1 \\ E^2 \Delta^2 W - \Delta W &= p(x, y) + N_2 \end{aligned}\right\} \text{ in the domain R,}$$

$F = F_n = W = W_n$ on the boundary R, where F is the modified stress function, W the deflection, E the stiffness, p the load, and N_1 and N_2 are nonlinear terms involving the second derivatives of F and W. Three approximate problems associated with this problem are: (a) Nonlinear membrane (stiffness of plate is considered to be very small); (b) Linear pla' (normal load very small); (c) Linear membrane (both are considered to be very small). This paper proves the existence of and estimates for solutions and also proves the validity of asymptotic expansions of the solution in terms of appropriate small quantities. These expansions indicate in what sense the solution to above formulated problem is approximated by the solutions to the 3 associated problems mentioned.

1805

New York U. Inst. of Mathematical Sciences, N. Y.

A BOUNDARY LAYER THEORY FOR ELASTIC PLATES, by K. O. Friedrichs and R. F. Dressler. [1959] [32]p. incl. diagrs. refs. (AFOSR-2465) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)161 and Office of Naval Research) Unclassified

Also published in Commun. Pure and Appl. Math., v. 14: 1-33, Feb. 1961.

The authors consider an elastic plate of uniform thickness in equilibrium loaded by normal shear stresses which vary arbitrarily along each edge generator and also around the perimeter, and by normal forces distributed arbitrarily over each face. The problem is governed by 3-dimensional linear elasticity equations and can be split into 2 independent parts, generalized plane-stress case and a pure-bending case. Only the pure-bending case is considered in detail. Expressions for stresses valid in the interior of the plate and in an edge layer are obtained by 2 expansion procedures which are interrelated by their boundary conditions. The lowest-order terms for the interior yield the classical thin-plate theory involving the biharmonic equation. The boundary-layer problem of corresponding order splits into 2 simpler equations, a plane-strain case and a torsion case, each now in a semi-infinite strip domain. Static equilibrium for the former implies the first Kirchhoff boundary condition on bending moments. The next higher approximation for interior stresses can be derived systematically, showing that its correct boundary conditions involve explicitly the boundary layer stresses of the thick-plate approximation. This analysis implies that the Mitchell 'moderately thick plate' theory is not applicable for the interior problem whenever any edge effect exists in a bent plate. Solutions for these edge stresses involve first other plane-strain and torsion problems for the stress derivatives. Integration then leads to 2 problems for the integration functions; these may be interpreted as plane-strain and torsion problems in which known boundary-layer stresses act as imposed body forces. Static equilibrium of the semi-infinite strip for this plane-strain case implies the second Kirchhoff boundary condition of the interior thin-plate theory, involving the sum of the resultant shear force and derivative of resultant twisting moment. (Contractor's abstract)

1806

New York U. Inst. of Mathematical Sciences, N. Y.

ITERATIVE SOLUTIONS FOR THE NON-LINEAR BENDING OF CIRCULAR PLATES, by H. B. Keller and E. L. Reiss. [1958] [20]p. incl. diagrs. table. (AFOSR-4356) (AF 49(638)161) Unclassified

Also published in Commun. Pure and Appl. Math., v. 11: 273-292, Aug. 1958.

Non-linear von Kármán equations for bending of a thin circular plate under uniform pressure were studied. Discussion is mainly concerned with plates clamped at the edges and with zero radial displacement, but analysis is valid for other edge conditions. Solution is by an iterative procedure whose convergence properties are studied by means of integral equations. Method is then applied to finite difference formulation of the differential solutions. Numerical results are concerned with previous work by other authors and the advantages of the present method are indicated. (Math. Rev. abstract)

1807

New York U. Inst. of Mathematical Sciences, N. Y.

A SPECIAL HILL'S EQUATION WITH DISCONTINUOUS COEFFICIENTS, by H. Hochstadt. Mar. 1960, 17p. incl. diagrs. (Research rept. no. BR-32) (AFOSR-TN-60-322) (AF 49(638)229) Unclassified

Also published in Amer. Math. Monthly, v. 70: 18-26, 1963.

The equation $y'' + \lambda^2 \rho(x) y = 0$ is investigated, where $\rho(x) = 1$ for $|x| \leq 1$ and $\rho(x) = a^2$ for $1 < |x| < L$. $\rho(x)$ is taken as a periodic function of period 2L and defined as above in the interval (-L, L). The nature of the characteristic values λ for which the equation has solutions of period L and 2L is investigated. Stability charts are drawn showing for which values of a^2 and λ all solutions are bounded, and for which some solutions are not bounded. The equation has numerous physical applications: (1) it can be derived from the problem of a vibrating string composed of 2 homogeneous pieces; (2) it can be applied to the propagation of a wave in a

1-dimensional structure where the index of refraction is an even periodic, piecewise constant function; and (3) it can be applied to resonant inductance capacitance circuits where the inductance or capacitance varies periodically with time. (Contractor's abstract, modified)

1808

New York U. Inst. of Mathematical Sciences, N. Y.

ON ELECTROMAGNETIC EIGENFUNCTION IN CLOSED CAVITIES, by H. Niemeyer. Aug. 1960, 45p. incl. refs. (Research rept. no. BR-34) (AFOSR-TN-60-1103) (AF 49(638)229) AD 245335; PB 152727 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 7: 412-433, 1961.

Some asymptotic statements about the electromagnetic eigenfunctions in closed cavities are proved. For this purpose, the behavior of the corresponding Green's tensors are investigated and a Tauberian theorem for Laplace transformations, which will also yield the asymptotic statements, is applied to the result.

1809

New York U. Inst. of Mathematical Sciences, N. Y.

EXPANSION PROBLEMS ARISING FROM THE WATSON TRANSFORMATION, by E. Pfiumm. Oct. 1960, 42p. (Research rept. no. BR-35) (AFOSR-TN-60-1242) (AF 49(638)229) AD 254787; PB 154560 Unclassified

The Watson transformation permits us to express the radial dependency of certain wave functions in terms of Hankel functions of complex order. These Hankel functions may be considered as eigenfunctions of a non-selfadjoint boundary value problem for Bessel's differential operator. It turns out that in general an arbitrary function cannot be expanded in a series involving these eigenfunctions, not even if very strong conditions are imposed on the arbitrary function. However, there exist sufficiently weak non-selfadjoint perturbations of a selfadjoint problem connected with Bessel's operator for which an expansion theorem for an arbitrary function in terms of the eigenfunctions can be proven. (Contractor's abstract)

1810

New York U. Inst. of Mathematical Sciences, N. Y.

SIMPLE PROOFS OF THE THEOREMS OF J. S. LOMONT AND H. E. MOSES ON THE DECOMPOSITION AND REPRESENTATION OF VECTOR FIELDS, by J. B. Keller. [1960] [4]p. (AFOSR-2466) (AF 49-(638)229) Unclassified

Also published in Commun. Pure and Appl. Math., v. 14: 77-80, Feb. 1961.

J. S. Lomont and H. E. Moses have proved 2 theorems about the decomposition and representation of 3-dimensional vector fields. The first is analogous to the first Helmholtz theorem which asserts that every differentiable 3-dimensional vector field is the sum of a field whose curl is zero and another whose divergence is zero. The second is analogous to the second Helmholtz theorem that every field with vanishing curl is the gradient of a scalar function while every field with vanishing divergence is the curl of a vector field. Lomont and Moses prove their theorems by representing the fields as series of spherical harmonics and then use rather involved group-theoretic considerations. One of the purposes of the present note is to present simpler and more direct proofs. The second purpose is to show, by means of a counterexample, that part of the second theorem is false unless the fields are defined and single valued in a full spherical shell centered at the origin. Thus this theorem is global in contrast to the second Helmholtz theorem which is local. This fact was not indicated by the original proof, which required single valuedness in a full spherical shell from the outset.

1811

New York U. Inst. of Mathematical Sciences, N. Y.

STATISTICAL MECHANICS AND THE BOLTZMANN EQUATION, by R. M. Lewis. Jan. 1960, 8p. incl. diagr. (Research rept. no. HT-4) (AFOSR-TN-60-10) (AF 49(638)341) AD 233307; PB 146720 Unclassified

A single explicit solution of the initial value problem for the "hierarchy equations" of statistical mechanics is given. The leading term of the expansion is an integral which already resembles the Boltzmann collision integral. The integral is simplified by Green's method using the fact that all but a small portion of the initial configuration space of two particles, two-body interactions are described in terms of complete collisions. The equation is found to be satisfied by a time-averaged density function in agreement with Kirkwood. It is anticipated that the method can give generalizations of the Boltzmann equation to higher densities.

1812

New York U. Inst. of Mathematical Sciences, N. Y.

EQUATION OF STATE AND PHASE TRANSITION OF THE SPHERICAL LATTICE GAS, by W. Pressman and J. B. Keller. Feb. 1960 [33]p. incl. diagrs. tables. (Research rept. no. HT-5) (AFOSR-TN-60-297) (AF 49(638)341) AD 235375; PB 148985 Unclassified

Also published in Phys. Rev., v. 120: 22-32, Oct. 1, 1960.

The spherical lattice gas is a modification of the ordinary lattice gas in which the occupation number of each cell is permitted to be any real number rather than ± 1. However the sum of squares of the occupation numbers is required to equal the number of cells. This permits one to evaluate the partition function by integrating over

the surface of a certain sphere rather than by summing over lattice points on that surface. The partition function and the equation of state of the gas are evaluated in this way. It is found that in 3 dimensions the gas condenses, but not in 1 or 2 dimensions. Graphs of the phase transition curve and of the isotherms in 3, 2 and 1 dimensions are presented. The analytical work is simplified by taking advantage of the relationship between the properties of the lattice gas and of the Ising model of a ferromagnet. This relationship, demonstrated by C. N. Yang and T. D. Lee [Phys. Rev., v. 87: 410-419, 1952] for the ordinary lattice gas and Ising model, also applies to the spherical lattice gas and the spherical model of a ferromagnet. The properties of the latter were evaluated by T. H. Berlin and M. Kac [Phys. Rev., v. 86: 821-835, 1952]. Graphs of the isotherms of the spherical model of the magnet, which were found in the course of the work, are also presented. (Contractor's abstract)

1813

New York U. Inst. of Mathematical Sciences, N Y.

DYNAMICS OF NONLINEAR STOCHASTIC SYSTEMS, by R. H. Kraichnan. July 1960 [86]p. incl. diagrs. refs. (Research rept. no. HT-7) (AFOSR-TN-60-717) (AF 49(638)341) AD 245489; PB 152726 Unclassified

Also published in Jour. Math. Phys., v. 2: 124-148, Jan.-Feb. 1961.

A method for treating nonlinear stochastic systems is described. In this method, the true problem is replaced by models that lead to closed equations for correlation functions and averaged Green's functions. The model solutions are exact descriptions of possible dynamical systems and display certain consistency properties. The models involve a new stochastic element: Random couplings are introduced among an infinite collection of similar systems, the true problem corresponding to the limit where these couplings vanish. The method is first applied to a linear oscillator with random frequency parameter. The mean impulse-response function of the oscillator is obtained explicitly for two successive models. The results suggest the existence of a sequence of model solutions which converges rapidly to the exact solution of the true problem. Applications then are made to the Schrödinger equation of a particle in a random potential and to Burger's analog for turbulence dynamics. For both problems, closed model equations are obtained which determine the average Green's function, the amplitude of the mean field, and the covariance of the fluctuating field. The model solutions can be expressed as sums of infinite classes of terms from the formal perturbation expansions of the solutions to the true problems. (Contractor's abstract)

1814

New York U. Inst. of Mathematical Sciences, N. Y.

THE SOLUTION OF THE FUNCTIONAL DIFFERENTIAL EQUATION FOR THE STATISTICAL EQUILIBRIUM OF A CRYSTAL, by R. M. Lewis and J. B. Keller. Aug. 1960, 45p. incl. refs. (Research rept. no. HT-6) (AFOSR-TN-60-965) (AF 49(638)341) AD 245399; PB 152725 Unclassified

Also published in Phys. Rev., v. 121: 1022-1037, Feb. 15, 1961.

The s-particle distribution functions ($s = 1, 2, \cdots$) of classical equilibrium statistical mechanics are determined for a crystal, as power series in the temperature. They are obtained by solving Bogoliubov's functional differential equation. From the distribution functions, the thermodynamic functions of a crystal are computed as power series in the temperature. The leading terms in these series are the usual classical results which are customarily derived by assuming that the potential energy is a quadratic function of the particle displacements. The further terms, which depend upon the nonquadratic or anharmonic terms in the potential, provide corrections for the usual results, which become more important as the temperature increases. If only a few terms in the series are used, the results will be valid at temperatures low compared to some characteristic temperature of the crystal, e.g., the melting temperature. Since they are based on classical mechanics, the results are valid only at temperatures high compared to the Debye temperature. The series expansions of the distribution functions and thermodynamic functions may be viewed as the low-temperature analogs of the virial expansions, which are low-density expansions. As in the case of the virial expansions, all the terms are determined explicitly in analytic form, but their actual evaluation is difficult. (Contractor's abstract)

1815

New York U. Inst. of Mathematical Sciences, N. Y.

SOLUTION OF THE EQUATIONS OF STATISTICAL MECHANICS, by R. M. Lewis. [1960] [10]p. (AFOSR-728) [AF 49(638)341] Unclassified

Also published in Jour. Math. Phys., v. 2: 222-231, Mar.-Apr. 1961.

The solution of the initial value problem for Bogoliubov's functional differential equation of nonequilibrium statistical mechanisms is obtained. This solution is then expanded in an infinite power series in the density which has the advantage that the calculation of the leading terms requires the solution of s-body problems only for small values of s. A derivation of the equilibrium equations by reduction from the nonequilibrium equation is included. These results are applied to obtain a simple derivation of the Boltzmann equation. (Contractor's abstract)

1816

New York U. Inst. of Mathematical Sciences, N. Y.

MEASURE-THEORETIC FOUNDATIONS OF STATISTICAL MECHANICS, by R. M. Lewis. [1960] [27]p. [AF 49(638)341] Unclassified

Published in Arch. Rational Mech. and Anal., v. 5: 355-381, 1960.

The basic formulas of classical equilibrium statistical mechanics are derived from well-known theorems in measure theory and ergodic theory. The method used is a generalization of the methods of Khinchin and Grad and deals with several, in fact a "complete set", of "invariants" or "integrals of the motion". Most of the results are simple corollaries of Birkhoff's ergodic-theorem, and since time-averages are used, the whole approach is characterized by an absence of statistical "ensembles" and probability notions. In the course of the development a "generalized temperature" is introduced, and a generalization of the second law of thermodynamics is derived. Formulas for the "microcanonical", "canonical", and "grand canonical" distributions appear as special cases of the general theory. (Contractor's abstract)

1817

New York U. Inst. of Mathematical Sciences, N. Y.

ON THE PROPAGATION OF CYLINDRICAL SHOCK WAVES, by A. Sakurai. [1959] 6p. incl. diagrs. (AFOSR-TN-60-173) (AF 49(638)446) Unclassified

Also published in Exploding Wires; Conf. on the Exploding Wire Phenomenon, Boston (Apr. 2-3, 1959), New York, Plenum Press, p. 264-270.

An improvement is given for the Taylor-type solution for the cylindrical shock wave from an exploded wire. The region treated is the stage where the shock is weaker before it reaches distances sufficient to assure the condition of instantaneous energy release. The quantity $J = 1/m + 4(1/2\ \gamma h_0 f_0^2 + a/\gamma-1) + g_0 - a/2(\gamma-1) + b/\gamma-1\ (1/m + 4 - 1/2)\lambda$ found by the improved assumption is substituted into $(J - y\ dJ/dy)\lambda = 2J - 1/\gamma-1\ y$, $J = \int_0^1 (1/2\ \gamma\ hf^2 + 1/\gamma-1\ g)xdx$. The solution obtained by numerical integration finds good agreement with the results obtained by an experiment carried out by Oshima.

1818

New York U. Inst. of Mathematical Sciences, N. Y.

ON THE PROBLEM OF A SHOCK WAVE ARRIVING AT THE EDGE OF A GAS, by A. Sakurai. [1959] 24p. incl. tables. (AFOSR-TN-60-174) (AF 49(638)446) AD 248756 Unclassified

Also published in Commun. Pure and Appl. Math., v. 13: 353-370, Aug. 1960.

The phenomena are discussed which may be expected when a shock wave propagates through a nonuniform medium of decreasing density and reaches the boundary where the density vanishes. The problem is considered in two parts. The first part corresponds to the stage before the shock wave arrives at the boundary; the second part corresponds to the subsequent expansion of the gas into the vacuum.

1819

New York U. Inst. of Mathematical Sciences, N. Y.

[HIGH SPEED GAS DYNAMICS]. Final rept. Aug. 1960, 7p. (Rept. no. IMM-NYU 272) (AFOSR-TR-60-93) (AF 49(638)446) AD 244213 Unclassified

This report gives an outline of future work that is anticipated or in progress under this contract. The results to date have been published (item nos. 1359 and 1360, Vol. III, and item nos. 1817 and 1818, Vol. IV). The work that is yet to be completed is the propagation of shock waves through non-uniform regions, structure of magnetohydrodynamic shock waves, 3-shock intersection, boundary-layer transition to turbulence, solar spicules, and secondary shocks within spherical and cylindrical blasts.

1820

New York U. Physics Dept., N. Y.

CHARGE-TRANSPORT PROCESSES IN ORGANIC MATERIALS, by H. Kallmann and M. Pope. [1960] [25]p. incl. diagrs. refs. (Sponsored jointly by Air Force Cambridge Research Center under AF 19(604)5495, Air Force Office of Scientific Research under AF 18-(600)1004, and Office of Naval Research under Nonr-28541) Unclassified

Published in Symposium on Electrical Conductivity in Organic Solids, Duke U., Durham, N. C. (Apr. 20-22, 1960), New York, Interscience Publishers, 1961, p. 1-25.

Observations made of the more elementary processes of charge motion and displacement in organic materials are described and discussed with respect to the following aspects: (1) Static phenomena pertaining to persistant internal polarization and photovoltaic effects; (2) conductivity phenomena pertaining to dark conductivity and photoconductivity; and (3) current multiplication with large field strengths. It is concluded that the predominant charge carrier is positive, the negative carriers are trapped within the sample, and the positive carriers are trapped mostly near the boundaries. The electrode material can effect the conductivity, especially if electrolyte solutions are used as electrodes.

1821

New York U. Physics Dept., N. Y.

COMPARISON OF THE SENSITIVITIES OF THE BEAM MASER AND CAVITY ABSORPTION SPECTROMETERS, by Y. Beers. Aug. 19, 1960 [5]p. incl. refs. (AFOSR-TN-60-951) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)259 and Office of Naval Research under Nonr-28535) AD 254849 Unclassified

Also published in Rev. Scient. Instr., v. 32: 23-27, Jan. 1961.

A formula for the signal-to-noise ratio of a maser spectrometer is derived by considering it as a special case of a cavity spectrometer. This formula is consistent with evaluations made by previous authors but is more convenient for comparison with an absorption cavity spectrometer. In applications where high resolution is not a requirement, the pressure and power level in an absorption spectrometer may be made very large so that its sensitivity can be superior to that of the maser. However, if it is operated to obtain the highest possible resolution, its sensitivity may or may not be superior to that of the maser, depending upon the frequency and upon other conditions. In the situation of greatest interest, in which the linear dimensions of the cavity are scaled in proportion to the wavelength and in which it is sufficiently large to make the effect of collisions between the molecules and the walls negligible, it is shown that the sensitivity of the maser relative to the absorption spectrometer varies inversely with the frequency. (Contractor's abstract)

1822

New York U. [Physics Dept.] N. Y.

HYPERFINE SPLITTING OF $3_2 \rightarrow 3_3$ TRANSITION OF HDO (Abstract), by E. B. Treacy and Y. Beers. [1960] [1]p. [AF 49(638)259) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 241, Apr. 25, 1960.

The observation of low-frequency transitions present the opportunity to resolve very small hyperfine splittings with an absorption method provided that the cell is large enough to eliminate wall collisions because the Doppler width decreases with the frequency while the hyperfine splitting bears no systematic dependence on frequency. Using a cavity spectrometer driven by a parametric up converter and followed by a superheterodyne receiver, the $3_2 \rightarrow 3_3$ line of HDO at 825 mc was studied. The minimum full line width at half maximum is 10 kc. Seven satellites have been well resolved on each side of the main line, and their frequencies are being measured. These data will be analyzed for determination of the deuteron quadrupole coupling constant and the I-J coefficients for comparison with the recent maser observation of the $2_1 \rightarrow 2_2$ line by Thaddeus and Loubser.

1823

New York U. [Physics Dept.] N. Y.

GEOGRAPHICAL ASPECTS OF COSMIC-RAY STUDIES, by S. A. Korff. [1960] [19]p. incl. illus. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)635], Atomic Energy Commission, and Office of Naval Research) AD 247388 Unclassified

Also published in Geog. Rev., v. 50: 504-522, Oct. 1960.

Some of the factors concerning the locations of the chain of cosmic-ray stations, particularly those at high elevations, and a justification of the necessity for these stations is reviewed. A single narrow stream of particles arriving at the earth would strike in an impact zone, which as the earth rotated, would sweep out an annulus around the earth. The optimum location for observing stations is in the region most likely to intercept such impact zones. A discussion follows which points out the nature of the studies to be made and their importance in providing greater mastery over the earth's environment. A list and evaluation of the general characteristics and problem of the world's high-altitude stations are given. Projected research directions are briefly summarized.

1824

New York U. Physics Dept., N. Y.

EFFECT OF GASEOUS INPURITIES ON BF_3 PROPORTIONAL COUNTERS, by J. D. Aponte and S. A. Korff. [1960] [5]p. incl. diagrs. refs. [AF 49(638)635] Unclassified

Published in Rev. Scient. Instr., v. 31: 532-536, May 1960.

The effect which SiF_4, SO_2, and SF_6 have on the plateau and the pulse size distribution of a proportional counter were investigated. SiF_4 was tested at three pressures, 30, 45, and 60 cm, of BF_3 and its effect was found to be independent of the counter pressure for the range of value considered. From the variation in the plateau, the attachment probability for SiF_4 was calculated to be $h = 1.485 \times 10^{-5}$ and its cross section for attachment to be $\sigma_a = 5.12 \times 10^{-20}$ cm^2. The amount of these gases permitted, without the counter being affected beyond the limits of tolerance which are set up, were found to be 0.04% for SiF_4, 0.01% for SO_2, and 2.0×10^{-6}% for SF_6. (Contractor's abstract)

1825

New York U. [Physics Dept.] N. Y.

HIGH NEUTRON AND RADIATION INTENSITIES AT BALLOON ALTITUDES DURING AURORAL DISPLAY, by S. A. Korff and R. C. Haymes. [1960] [5]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)635] and Office of Naval Research) Unclassified

Published in Jour. Geophys. Research, v. 65: 3163-3167, Oct. 1960.

A balloon flight at 40-km altitude, instrumented with neutron counters, recorded high neutron intensities as well as high ionization levels during an auroral display.

Because the system employed 2 counters differing in their sensitivity to neutrons, a separation of counts due to neutrons from those due to highly ionizing events was possible. This shows that large numbers of neutrons were present at the altitude of this balloon at the time of the aurora. A great deal of ionizing radiation was also present, as recorded by the second counter. The experiment was not designed to determine if the radiation was protons, electrons, or x-radiation but by describing the properties of each, it is concluded that protons produced the radiation.

Nobel Inst. for Neurophysiology, Stockholm (Sweden).
see Karolinska Inst. Nobel Inst. for Neurophysiology, Stockholm (Sweden).

1826

Nobel Inst. for Physics, Stockholm (Sweden).

A NEW SOLUTION OF THE FINITE RISE TIME PROBLEM BY MEANS OF A DISTRIBUTED AMPLIFIER WITH AUTOMATIC GAIN CONTROL, by B. Johansson. Dec. 15, 1959 [7]p. incl. diagrs. (Technical note no. 1) (AFOSR-TN-60-164) (AF 61(052)118) AD 232064
Unclassified

Also published in Nucl. Instr. and Methods, v. 6: 201-205, Jan. 1960.

In a distributed amplifier the output pulse is built up by the addition of pulses from subsequent stages. If this sum up is stopped when the pulses have reached a certain pulse-height level then the output pulses will have the same height and, what is essential in time measurements, the same shape independent of the height of the input pulse within a certain pulse-height range. A distributed amplifier based on this principle is described. It consists of 2 cascaded 5-tube amplifiers with a risetime 8 ns and covers a pulse-height range of 15 db. By a conveniently chosen combination of number of tubes and cascaded amplifiers, any desired pulse-height range can be covered. The amplifier can be built for fast as well as slow phosphors. (Contractor's abstract)

1827

Nobel Inst. for Physics, Stockholm (Sweden).

THE OSCILLOSCOPE METHOD OF MEASURING NUCLEAR HALF-LIVES, by I. Bergström, E. Bonacaiza and others. Feb. 1, 1960 [38]p. incl. diagrs. table, refs. (Technical note no. 2) (AFOSR-TN-60-295) (AF 61(052)118) AD 234429; PB 146643
Unclassified

Also published in Nucl. Instr. and Methods, v. 8: 151-172, Aug. 1960.

It is shown that the modern fast oscilloscopes now available commerically are very simple and powerful tools for measuring nuclear half-lives. The advantages and the limitations of the method are discussed. In order to illustrate the problems which are associated with measurements in different half-life regions, seven half-lives associated with metastable states in nuclei were measured. The oscilloscope method can be used in the whole region where conventional delayed coincidence technique is applicable. It is significant for the usefulness of the method, that when studying half-lives which were reasonably well known a new half-life for Pb^{203} was discovered (55 mμ sec). A great advantage of the oscilloscope method is that above approx 1 μ sec it can be very easily used as a multi-channel time analyzer by continuously photographing the events on the oscilloscope screen. (Contractor's abstract)

1828

Nobel Inst. for Physics, Stockholm (Sweden).

USE OF CATHODE RAY TUBES IN PULSE-HEIGHT SPECTROSCOPY, by P. Thieberger and L. Bergström. [1960] 14p. (Technical note no. 4) (AFOSR-226) (AF 61(052)118) AD 254971; PB 155782 Unclassified

Also published in Nuc. Instr. and Methods, v. 10: 315-321, Apr. 1961.

The possibility of using cathode ray oscilloscopes for pulse height analysis in gamma ray measurements was studied. Two ways of generating signals obtained when the beam of a CRT hits a certain part of its screen were used for single channel manual (one oscilloscope used) and automatic (two oscilloscopes used) analysis of pulse spectra from NaI-crystal detectors. The signals were obtained either by viewing the screen of a conventional CRT by means of a photomultiplier tube or by making use of a specially designed CRT provided with additional interval electrodes from which pulses were directly derived. From the results obtained, it was concluded that the equipment described is well suited for energy and intensity comparisons of gamma rays. It is shown that the energy linearity is good and that it is possible to record photo peaks corresponding to gamma-energies as low as about 5 kev. Compared to conventional set-ups, this arrangement showed several advantages with no additional limitations. (Contractor's abstract)

1829

North American Aviation, Inc. Missile Div., Downey, Calif.

EFFECT OF ROUGHNESS ON TRANSITION IN SUPERSONIC FLOW, by E. R. van Driest and C. R. Blumer. Mar. 1960, 36p. incl. illus. diagrs. tables. (Rept. no. MD-60-329) (AGARD rept. no. 255) (AFOSR-TN-60-1164) (AF 49(638)250) AD 249996; AD 262485; PB 153743
Unclassified

Presented at Boundary Layer Research Meeting of the AGARD Fluid Dynamics Panel, London (England), Apr. 25-29, 1960.

Experiments were carried out in the 12-in. supersonic wind tunnel to investigate the effect of 3-dimensional roughness elements (spheres) on boundary-layer transition on a 10° apex angle cone without heat transfer

The local Mach number for these tests was 2.71. The data show clearly that the minimum (effective) size of trip required to bring transition to its lowest Reynolds number varies as the one-fourth power of the distance from the apex of the cone to the trip. Use of available data at other Mach numbers indicates that the Mach number influence for effective tripping is taken into account by the simple expression $Re_{\delta}^{*} = 1050(1 + \gamma\text{-}1/2\ M_{\delta}^{2})\ (k/\delta^{*})^{-2}$. (Contractor's abstract)

1830

North American Aviation, Inc. Rocketdyne Div., Canoga Park, Calif.

DISPLACEMENT AND SHATTERING OF PROPELLANT DROPLETS, by E. Rabin, A. R. Schallenmuller, and R. B. Lawhead. Final summary rept. Mar. 1960, 117p. incl. illus. diagrs. tables, refs. (Rept. no. R-2431) (AFOSR-TR-60-75) (AF 18(603)98) AD 241473; PB 150143 Unclassified

Studies in shock tubes were conducted to determine the effect of shock waves on the shattering and drag of burning and nonburning liquid fuel droplets. The effect of flow velocity, flow duration, surface tension, and chamber pressure on the breakup characteristics were studied. The critical velocity that would just cause droplet breakup (burning or not) for short-duration flow was found to agree with the equation: $We\ Re^{-1/2} \cong 0.45$. The drag coefficient for burning and nonburning drops was found to be approximately $C_D = 1.0$. A special model rocket thrust chamber was used to study the effect of relative gas and propellant displacement due to acoustical modes as a sustaining physical process for combustion instability. This relative displacement is found to affect the relative stability of various injectors having different propellant distributions; however, no quantitative correlations could be established in the particular apparatus chosen for these studies. It is concluded that this apparatus does not adequately model combustion in large liquid rocket engines due to the low axial velocity of the burnt gases in it. (Contractor's abstract)

1831

North American Aviation, Inc. Rocketdyne Div., Canoga Park, Calif.

EXPERIMENTAL ELECTRICAL PROPULSION STUDY, by C. R. Dulgeroff and G. D. Seele. Final rept. May 1, 1958 - May 31, 1960. July 1960, 65p. incl. illus. diagrs. tables, refs. (Rept. no. R-2565) (AFOSR-TR-60-112) (AF 49(638)351) AD 243217 Unclassified

The investigation of ion thrust chamber geometry, using both an accelerate-decelerate electrode geometry and a modified Pierce 2-electrode geometry design, showed the latter design to be superior inasmuch as it showed improved focusing properties, i.e., a decrease of beam interception by the acceleration electrode. The perveance of the latter system was experimentally determined to be 3.45×10^{-9} amp/volt$^{3/2}$. Current densities for plane ionizer surfaces up to about 12 ma/cm^2 for either tungsten, tantalum, or titanium carbide ionizers were measured by using a calorimetric collector. Thrust measurements of 40 to 50 micropounds were made by a pendulum-type collector. Other performance tests showed a sputtering rate of about 22 gm/amp hr for 9-kev cesium ions on nickel and an ionization efficiency of greater than 90% over a 30-hr period. Tungsten, molybdenum, nickel, and 321 stainless steel are generally compatible with cesium at 700°C but at 1000°C, intergranular attack of nickel and moderate to severe pitting of stainless steel by cesium occurs over reaction periods of 100 hr. (Contractor's abstract)

1832

North American Aviation, Inc. Rocketdyne Div., Canoga Park, Calif.

EXPERIMENTAL STUDIES WITH SMALL-SCALE ION MOTORS, by C. R. Dulgeroff, R. C. Speiser, and A. T. Forrester. [1960] [3]p. incl. illus. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)351 and Wright Air Development Center under AF 33(616)5927) Unclassified

Presented at Fourteenth annual meeting of the Amer. Rocket Soc., Washington, D. C., Nov. 16-20, 1959.

Published in ARS Jour., v. 30: 761-763, Aug. 1960.

Cesium surface ionization ion sources in ion motor configurations were operated. Ion beam power and thrust levels per unit ionizer area up to 177 w/cm^2 and 5.6×10^{-4} lb/cm^2 have been achieved. In mass utilization studies it is found that 70% of the cesium used reached the collector as high energy ions, and over 90% is ionized at the ionizer. The injection of electrons into the ion beam for neutralization purposes is accomplished by the operation of a thermionic emitter near the exit aperture of the motor, the electrons being accelerated into the beam by the ion space charge fields. (Contractor's abstract)

1833

[North American Aviation, Inc. Rocketdyne Div., Canoga Park, Calif.]

ION PROPULSION AT ROCKETDYNE (Abstract), by by T. M. Littman. [1960] [3]p. (Bound with its AFOSR-TN-60-405; AD 235949) (AF 49(638)649) Unclassified

Presented at Third AFOSR Contractor's meeting on Ion and Plasma Propulsion, Republic Aviation Corp., Farmingdale, N. Y., Mar. 22-24, 1960.

As a prelude to the development of a useful ion rocket engine, an integrated program of analytical and experimental research is being pursued on all phases of ionic propulsion. The immediate goal is thorough understanding of the low thrust technique. The major problem

areas are investigated by means of a laboratory-scale ion thrust device, simulation techniques, theoretical studies and mission analyses. The theoretical studies include 4 efforts: (1) investigation of the phenomena occurring within the accelerator region, such as power loss through beam compression, power loss by thermal radiation, electrode erosion by sputtering processes, scattering of ions by neutrals, thermionic emission from electrodes, thermal beam spreading and photoelectric emission; (2) study of the beam dynamics in the external electrode region including beam neutralization and beam stability; (3) evaluation of propellants; and (4) analysis of arc sources. A diversity of mission studies was performed: spiral orbits, earth escape, vehicle orientation control, planar orbit modification, payload weight maximization and generalized mission optimization.

1834

[North American Philips Co., Inc.] Philips Labs., Irvington-on-Hudson, N. Y.

NOISE STUDIES ON TWO-CAVITY CW KLYSTRONS, by G. A. Espersen. [1960] [4]p. incl. illus. diagrs. (Sponsored jointly by Air Force Cambridge Research Center under AF 19(604)454 and AF 18(604)1080 and Air Force Office of Scientific Research under AF 18-(603)33) Unclassified

Published in I. R. E. Trans. on Microwave Theory and Tech., v. MTT-8: 474-477, Sept. 1960.

The noise properties of a 2-cavity CW 3-cm klystron oscillator are discussed with the purpose of studying the noise contribution located close to the center frequency in the audiofrequency range. A system permitting measurements to be made of the mean square frequency deviation is described. Comparisons are made indicating the noise performance of the klystron oscillator when operated under air-cooled and water-cooled conditions. (Contractor's abstract)

1835

[North American Philips Co., Inc.] Philips Labs., Irvington-on-Hudson, N. Y.

INTERPRETATION OF DIFFRACTOMETER LINE PROFILES DISTORTION DUE TO THE DIFFRACTION PROCESS, by J. Ladell. [1959] [7]p. incl. refs. (AFOSR-TN-60-60) [AF 49(638)620] Unclassified

Also published in Acta Cryst., v. 14: 47-53, Jan. 1961.

On the basis of the kinematic theory of powder diffraction it is shown that the angle factor $J(\theta) \propto \sin^2 \theta \cos \theta/(1 + \cos^2 2\theta)$ describes the distortion of the line profile due to the diffraction process when the incident radiation consists of a spectral distribution $h_1(\lambda)$ the angle scale equivalent of which is $h(\epsilon)$. The distortion includes the effects of the Lorentz and polarization factors, trigonometric factors associated with the experimental powder method, and the effects of physical absorption. In the absence of other aberrations the angle scale spectral distribution $h(\epsilon)$ is (to the first order) recovered from the observed distribution $f(\epsilon)$ from the equation $f(\epsilon)J(\theta) = h(\epsilon)$. Δ_{LPU}, the correction to be applied to counterbalance the shift in the observed profile due to the distortion of the profile caused by the diffraction process, is inferred from $J(\theta)$ and is applicable to crystal powders encountered in precision lattice parameter determinations. (Contractor's abstract)

1836

North American Philips Co., Inc. Philips Labs., Irvington-on-Hudson, N. Y.

COMPARISON OF VARIOUS MEASURES OF LINE POSITION IN POWDER DIFFRACTOMETRY (Abstract), by J. Ladell, M. Mack and others. [1960] [1]p. (AFOSR-3079) (AF 49(638)620) Unclassified

Presented at meeting of the Amer. Cryst. Assoc., Washington, D. C., Jan. 27, 1960.

Various methods of fixing reference points on line profiles have been used as measures of the Bragg angle position. These methods which include the peak, median, mid-point of chords at various heights, etc. lead to different values of the lattice parameter. This inconsistency is not removed by extrapolation procedures. The selection of these various methods of defining a Bragg angle position does not take into account the significant aspects of the diffraction process or facilitate the corrections of the data for systematic errors inherent in the experimental arrangement. The magnitude of these effects is demonstrated with experimental data and some of the theoretical aspects of the problem are discussed.

1837

North American Philips Co., Inc. Philips Labs., Irvington-on-Hudson, N. Y.

PRESENT STATUS OF PRECISION LATTICE PARAMETER DETERMINATION BY COUNTER DIFFRACTOMETRY (Abstract), by W. Parrish and J. Ladell. [1960] [1]p. (AFOSR-3080) (AF 49(638)620) Unclassified

Presented at Fifth Internat'l. Union of Crystallography Cong., Cambridge (Gt. Brit.), Aug. 15-24, 1960.

Also published in Acta Cryst., v. 13: 992, 1960.

A summary of the various factors involved in the diffractometric determination of lattice parameters is presented. It is shown that various commonly used measures of the reflection angles such as the mode, bisectors-of-chords, etc. with the same or different wavelengths do not lead to a unique value of the lattice parameter.

1838

[North American Philips Co., Inc.] Philips Labs., Irvington-on-Hudson, N. Y.

THE LORENTZ FACTOR IN POWDER DIFFRACTION,

by E. R. Pike and J. Ladell. [1960] [2]p. incl. tables. (AFOSR-3081) (In cooperation with Massachusetts Inst. of Tech., Cambridge) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)-620]; and Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [DA 36-039-sc-78108]) Unclassified

Also published in Acta Cryst., v. 14: 53-54, Jan. 1961.

In a recent communication, a correction was suggested to be applied to the centroids of powder-diffraction lines for the purpose of counteracting the shift from true Bragg position caused by the effect of the Lorentz and polarization factors. More recently values of this correction have been calculated by Ladell, Mark, Parrish, and Taylor (Acta Cryst., v. 12: 567, 1959) and Pike (Acta Cryst., v. 12: 87, 1959). In the present note, both of the above works are re-examined in order to clarify certain divergent concepts of the Lorentz factor and to resolve a small discrepancy in calculations. The results indicate that the approximations which lead to the characterization of the correction in terms of the variance and mean wavelength are reasonable and that there is no significant difference between the numerical approach of Ladell, et al, and Pike.

1839

North Carolina U. Dept. of Chemistry, Chapel Hill.

APPLICATIONS OF COMPLEMENTARY TRISTIMULUS COLORIMETRY, by C. N. Reilley and E. M. Smith. May 1960 [26]p. incl. diagrs. tables (Rept. no. UNC-Chem. no. 5-CNR) (AFOSR-TN-60-497) (AF 49(638)-333) AD 240176 Unclassified

Also published in Anal. Chem., v. 32: 1233-1240, Sept. 1960. (Title varies)

The principles of complementary tristimulus colorimetry have been extended in mathematical form to several problems of analytical interest. Colorimetric analysis of multicomponent mixtures is 1 possible application. While the analysis of a single component is trivial, the use of complementary tristimulus colorimetry in the case of 2 and 3 components with overlapping spectra is feasible. The technique has the advantage that more than the minimum number of wavelengths can easily by employed. While the tristimulus approach is limited to a maximum of 3 components, an analogous multistimulus approach can be used for a system containing more components. Other applications include calculation of the pK's of acids, and the formula and stability constant of complex ions. As an aid in computation, an inexpensive analog computer was built which permits calculation of chromaticity coordinates (by the weighted ordinate method at 10 selected wavelengths) in about 2 to 3 min. (Contractor's abstract)

1839

North Carolina U. [Dept. of Chemistry] Chapel Hill.

CHRONOPOTENTIOMETRY WITH CURRENT REVERSAL, by R. M. King and C. N. Reilley. Mar. 16, 1960 [13]p. incl. diagr. table. (Rept. no. UNC-Chem. no. 4-CNR) (AFOSR-TN-60-766) (AF 49(638)333) AD 241599; PB 150121 Unclassified

Also published in Jour. Electroanal. Chem., v. 1: 434-442, 1960.

The transition time ratios for chronopotentiometry with current reversal are derived for the case in which the product of the forward electrochemical reaction decomposes immediately and irreversibly to 2 or more species which are not electrochemically active at the potential of the forward reaction but which do react consecutive following current reversal. The usual assumptions of semi-infinite linear diffusion control of mass transport are made. The derived results are found to be in good agreement with the experimental results of Geske (Jour. Amer. Chem. Soc., v. 81: 4145, 1959). (Contractor's abstract)

1841

North Carolina U. Dept. of Chemistry, Chapel Hill.

METHODS OF DETECTING AND CONTROLLING METAL ION LEVELS, by C. N. Reilley. [1960] [11]p. incl. diagrs. table, refs. (AFOSR-2423) (AF 49(638)-333) AD 441853 Unclassified

Presented at Conf. on Biological Aspects of Metal-Binding, Pennsylvania State U., University Park, Sept. 6-9, 1960.

Also published in Fed. Proc., Suppl. 10, v. 20: 22-32, Sept. 1961.

Methods of detecting and controlling metal ion levels are reviewed as they pertain to simple situations with the expectation that such principles may be extended to biological systems. The nature of interactions which influence metal ion levels in aqueous systems of reasonably simple composition is discussed and the principles involved in the buffering of such metal ion concentrations by chelating agents are described. The metal-complex ratio, which has a strong bearing on the buffering ability of a metal-complex system and hence gives rise to behavior unlike that found in hydrogen ion buffers, is discussed in detail. Several of the important factors influencing metal ion levels are summarized, including the pH effect, the effect of metal ion hydrolysis, the effect of metal complex derivatives, and the effect of a second metal ion. The metal levels in the present work were determined via calculation of the pertinent equilibria and their equilibrium constants. Other techniques for determining metal levels include measurement by means of metal indicators, i.e. acid-base indicators, and by metal electrodes. The principles of these techniques with their limitations and possible scope of application are discussed.

1842

North Carolina U. [Dept. of Mathematics] Chapel Hill.

ON THE CHARACTERISTIC ROOTS OF

POWER-POSITIVE MATRICES, by A. Brauer. Oct. 1960, 13p. incl. refs. (Technical rept. no. 13) (AFOSR-TN-60-1032) (AF 18(603)38) AD 256215 Unclassified

Also published in Duke Math. Jour., v. 28: 439-443, Sept. 1961.

A matrix with real elements is called power-positive if a power of it is positive. It is shown that the most important properties of the characteristic roots of positive matrices also hold for power-positive matrices. In particular, the absolute greatest root of a power-positive matrix can be computed as exactly as needed without finding the characteristic equation. (Contractor's abstract)

1843

North Carolina U. Dept. of Physics, Chapel Hill.

THE "MEASURE" IN THE FEYNMAN QUANTIZATION OF GENERAL RELATIVITY, by B. S. DeWitt. Oct. 1959, 7p. (Publication no. 5) (AFOSR-TN-60-24) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)563] and Office of Naval Research under Nonr-85507) Unclassified

In a former paper (Rev. Mod. Phys., v. 29: 497, 1957), Misner extended Feynman's "sum over histories" technique to the quantum theory of gravitation. In doing so, he made the following choice for a measure in defining the functional integral to be taken over space time metrics: $\Delta = \prod_x g^{-5/2}(x)$. In this report it is shown that this measure violates the general covariance of the theory, a result which casts doubt on the validity of any consequences which stem from its use. It is noted that the action integral in the initial expression is itself invariant under coordinate transformations. In order for the entire expression to be coordinate invariant, therefore, it must simply be required that the functional "volume element" be coordinate invariant. But in order for this to be so, it is necessary and sufficient that $\partial(\Delta\rho^i{}_\mu)/\partial q^i = 0$. If this representation is transitive, then its solution is unique. If not, then Δ will not be completely determined. The latter proves to be the case, and it is shown that the solution of the above equation belongs to a restricted class of which Misner's measure is not a number.

1844

North Carolina U. Dept. of Physics, Chapel Hill.

INVARIANT COMMUTATORS FOR THE QUANTIZED GRAVITATIONAL FIELD, by B. S. DeWitt. Jan. 1960, 22p. incl. refs. (Publication no. 6) (AFOSR-TN-60-87) (AF 49(638)563) AD 233367; PB 146949 Unclassified

Also published in Phys. Rev. Ltrs., v. 4: 317-320, Mar. 15, 1960.

A resolution of the difficulties in applying quantum mechanics to Einstein's theory of gravitation caused by (1) the nonlinearity of the theory and (2) its coordinate invariance, which leads to constraints on the Cauchy data for the dynamical equations is presented. The basic commutators of the theory are given in covariant form. The applicability of the results obtained to classical and quantum theory is set up by an approach to commutators through the canonical theory of Poisson brackets. The derivations are based on the recognition of the action as the generator of a finite canonical transformation and on the use of the fundamental theorem of classical transformation theory.

1845

North Carolina U. Dept. of Physics, Chapel Hill.

QUANTIZATION OF FIELDS WITH INFINITE DIMENSIONAL INVARIANCE GROUPS, by B. S. DeWitt. Aug. 1960, 40p. (Publication no. 7) (AFOSR-TN-60-1199) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)563 and Office of Naval Research under Nonr-85507) AD 246406 Unclassified

Also published in Jour. Math. Phys., v. 2: 151-162, Mar.-Apr. 1961.

A general approach to the problems of quantizing fields which have infinite dimensional invariance groups is given. Space and time are treated on a completely equal footing. A Poisson bracket is defined by means of Green's functions, independently of the discovery or recognition of canonical variables, and is shown to satisfy all the usual identities. In accordance with the measurement theoretical foundations of the quantum theory, the Poisson bracket (i.e., commutator) is defined only for physically measurable group invariants. The Green's functions give a direct description of the propagation of small disturbances arising from a pair of mutually interfering measurements. In order to establish a correspondence between this approach and conventional canonical theory, a motivation for the adopted definition of the Poisson bracket is outlined with the aid of the fundamental theorem of canonical transformation theory. The rest of the discussion is logically independent of this, however. The general theory of wave operators and their associated Green's functions is briefly reviewed. Specific details connected with the group theoretical side of the theory are handled in such a way that problems of constraints are completely avoided. The general method of wave operators is applied to the Yang-Mills field, as a nontrivial example. The problem of factor ordering was not studied. (Contractor's abstract)

1846

North Carolina U. Dept. of Physics, Chapel Hill.

SPHERICAL GRAVITATIONAL WAVES, by I. Robinson and A. Trautman. [1960] [2]p. (AFOSR-3378) [AF 49(638)563] Unclassified

Also published in Phys. Rev. Ltrs., v. 4: 431-432, Apr. 15, 1960.

A class of solutions to Einstein's gravitational equations

for empty space are presented. The metric considered has the form $ds^2 = 2d\rho\, d\sigma + (\kappa - 2H\rho - 2m/\rho)d\sigma^2 \cdot \rho^2 p^{-2}\{[d\xi + (\partial q/\partial\eta)d\sigma]^2 + [d\eta + (\partial q/\partial\xi)d\sigma]^2\}$, where m is a function of σ only, p and q are functions of σ, ξ, η, $H = p^{-1}\,\partial p/\partial\sigma + p\partial^2 p^{-1} q/\partial\xi\partial\eta - pq\partial^2 p^{-1}/\partial\xi\partial\eta$, and K is the Gaussian curvature of the surface $\rho = 1$ $\sigma =$ constant, $K = p^2(\partial^2/\partial\xi^2 + \partial^2/\partial\eta^2)\ln p$. The solution is degenerate type I if m is nonzero and K is independent of ξ, η. It is then reducible to $m = 1$, $p \cos h\, \mu\, \xi$, $q = 0$, where μ is a real or purely imaginary constant. If μ is real and nonzero, this is Schwarzschild's solution for a mass μ^{-3}. If $(\partial K/\partial\xi)^2 + (\partial K/\partial\eta)^2 \neq 0$ and the empty-space equations are satisfied, the metric is type II non-null or type III, the condition for type III being $m = 0$.

1847

North Carolina U. Dept. of Physics, Chapel Hill.

THE QUANTIZATION OF GEOMETRY, by B. S. DeWitt. Nov. 1960 [116]p. incl. diagrs. tables. (Publication no. 8) (AFOSR-3491) (AF 49(638)563) AD 284913 Unclassified

Also published in Gravitation: An Introduction to Current Research, New York, Wiley and Sons, 1962, p. 266-381.

A self-contained exposition of the author's specific and somewhat unconventional approach toward the problem of quantization of the gravitational field is presented. The basic idea is to tackle the whole complex of problems on the basis of a general theory of measurement. The first part develops a consistent theory of measurement and a very general quantization formalism for arbitrary systems, while the second part applies the general formalism to the gravitational fields. (Math. Rev. abstract)

1848

North Carolina U. Dept. of Physics, Chapel Hill.

QUANTIZED MESON FIELD IN A CLASSICAL GRAVITATIONAL FIELD, by T. Imamura. [1960] [5]p. [AF 49(638)563] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 50, Jan. 27, 1960.

Also published in Phys. Rev., v. 118: 1430-1434, June 1, 1960.

The behavior of a quantized meson field in a classical gravitational field is examined. Physical quantities such as the expectation value for the number of created mesons are represented in terms of a formal Green's function. They are computed explicitly for the case of a special space-independent gravitational field. The inadequacy of standard iteration procedure is discussed.

1849

North Carolina U. [Dept. of Physics] Chapel Hill.

ROOM-TEMPERATURE DISLOCATION DECORATION INSIDE LARGE CRYSTALS, by C. B. Childs and L. Slifkin. Nov. 7, 1960 [5]p. incl. illus. (AFOSR-TN-60-1371) (AF 49(638)865) AD 247890 Unclassified

Also published in Phys. Rev. Ltrs., v. 5: 502-503, Dec. 1, 1960.

The usual technique for decoration of dislocations in ionic crystals generally requires a high-temperature annealing treatment; otherwise, only those dislocations near the crystal surface will be displayed. For the study of some aspects of the plasticity of ionic crystals, it would be desirable to have a means of observing dislocation configurations throughout large regions of the sample interior without the need of an annealing procedure. Such a technique is described. After production of only moderate print-out densities by means of the Haynes-Shockley method, a room temperature aging of the crystal results in extensive migration of Ag from random submicroscopic specks into the dislocations. After a period of several days the dislocations are so sharply decorated relative to the diffuse background that they are readily observed. It is concluded that the electron traps of greatest total cross-section inside the crystal are not dislocations, and that the most stable sites of the final precipitated Ag are largely at dislocations.

1850

North Carolina U. [Inst. of Statistics] Chapel Hill.

SECOND ORDER ROTATABLE DESIGNS IN FOUR OR MORE DIMENSIONS, by N. R. Draper. [1959] [11]p. incl. tables. (AF 18(600)83) Unclassified

Published in Ann. Math. Stat., v. 31: 23-33, Mar. 1960.

It is shown how the method employed previously by Bose and Draper (item no. 1387, Vol. III) may be used to obtain infinite classes of second order rotatable designs in dimensions higher than 3 by a suitable generation and combination of basic point sets. Also presented is a method for adding to a second order rotatable design in (k-1) dimensions in order to convert it to a second order design in k dimensions.

1851

North Carolina U. Inst. of Statistics, Chapel Hill.

THIRD ORDER ROTATABLE DESIGNS IN THREE DIMENSIONS, by N. R. Draper. [1959] [10]p. incl. tables. (In cooperation with Mathematics Research Center, Madison, Wisconsin) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)83 and [Office of Ordnance Research] under DA 11-022-ORD-2059) Unclassified

Published in Ann. Math. Stat., v. 31: 865-874, Dec. 1960.

A general theorem is proved that provides the conditions under which a third order rotatable arrangement of points in k dimensions is non-singular. The 4 previously known third order designs in 3 dimensions are stated; it is then shown how some of the second order design classes constructed earlier by Bose and Draper (item no. 1387, Vol. III) may be combined in pairs to give infinite classes of sequential third order rotatable designs in 3 dimensions. (Contractor's abstract)

1852

North Carolina U. [Inst. of Statistics] Chapel Hill.

AN UPPER BOUND FOR THE VARIANCE OF KENDALL'S "TAU" AND OF RELATED STATISTICS, by W. Hoeffding. [1960] [7]p. (AF 18(600)458) Unclassified

Published in Contributions to Probability and Statistics, Stanford U. Press, 1960, p. 258-264.

Let $X_1, X_2 \cdots, X_n$ be independent and identically distributed random variables (real-or vector-valued). Let $f(X_1, X_2)$ denote a bounded function such that $f(X_1, X_2) = f(X_2, X_1)$. It is assumed that the bounds are $0 \leq f(X_1, X_2) \leq L$. Let $U = \frac{2}{n(n-1)} \sum_{1 \leq i \leq j \leq n} f(X_i, X_j)$. It is shown that under the above conditions, $r-p^2 \leq H(p) = p^{3/2} - p^2$ when $p \geq 1/2$, and $= (1-p)^{3/2} - (1-p)^2$, when $p \leq 1/2$.

1853

North Carolina U. [Inst. of Statistics] Chapel Hill.

ON THE POWER OF SOME RANK-ORDER TWO-SAMPLE TESTS, by J. R. Rosenblatt. [1960] [12]p. incl. table. (In cooperation with National Bureau of Standards, Washington, D. C.) [AF 18(600)458] Unclassified

Published in Contributions to Probability and Statistics, Stanford U. Press, 1960, p. 358-370.

A collection of small-sample results concerning properties of some rank-order two-sample tests with respect to various types of decision problems is reported. The methods used involve chiefly the manipulation of integrals arising in expressions for the probabilities of orderings of observations from two populations. Of primary importance is a class of pairs (F, G) of distributions for which the functional $\Theta(F, G) = \Pr(X < Y) = \iint \varphi(x, y)dF(x)dG(y) = E_{FG}\, \varphi(X, Y)$ is defined, where $\varphi(x, y) = 1$ if $x < y$ and 0 if $x \geq y$.

1854

North Carolina U. [Inst. of Statistics] Chapel Hill.

A GEOMETRY OF BINARY SEQUENCES ASSOCIATED WITH GROUP ALPHABETS IN INFORMATION THEORY, by R. C. Bose and R. R. Kuebler, Jr. [1959] [27]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-213] and Public Health Service) Unclassified

Published in Ann. Math. Stat., v. 31: 113-139, Mar. 1960.

It is shown that the construction of a binary signalling alphabet is equivalent to the selection of a set Ω of n points from PG (k-1, 2), the geometries point P_i appearing n_i times in Ω. The selection of Ω is in turn equivalent to the distribution of a total measure n over the points of PG (k-1, 2), whereby the non-negative integral measure $n(P_i) = n_i$ is attached to the point P_i, $\Sigma_{i=1}^{\mu} n_i = n$, $\mu = 2^k - 1$.

1855

North Carolina U. Inst. of Statistics, Chapel Hill.

PROPER SPACES RELATED TO TRIANGULAR PARTIALLY BALANCED INCOMPLETE BLOCK DESIGNS, by L. C. A. Corsten. [1959] [4]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)213 and Netherlands Organization for Pure Research) Unclassified

Published in Ann. Math. Stat., v. 31: 498-501, June 1960.

The proper spaces of the matrix NN^1, where N is the incidence matrix of a triangular partially balanced incomplete block design are exhibited completely. This provides a convenient form for the Gramian of a basis of the join of 2 of these spaces. (Contractor's abstract)

1856

North Carolina U. [Inst. of Statistics] Chapel Hill.

CHARTS ON SOME UPPER PERCENTAGE POINTS OF THE DISTRIBUTION OF THE LARGEST CHARACTERISTIC ROOT, by D. L. Heck. [1959] [18]p. incl. diagrs. refs. (AF 49(638)213) Unclassified

Published in Ann. Math. Stat., v. 31: 625-642, Sept. 1960.

A graphical representation is given of some upper percentage points of the distribution of the largest root for a wider range of the parameters s, m, and n. The parameters are given by $s = \min(p, q)$, $m = (|p - q| - 1)/2$, and $n = (N - p - q - 2)/2$. One of the most extensive tabulations to date is that by Pillai giving the upper 1% and 5% points and covering the range s = 2(1)5, m = 0(1)4, n = 5(5) 40(20) 100(30) 160, 200, 300, 500, 1000. Also, the upper 1% and 5% points for these same values of m and n have been obtained by Pillai for s = 6. Other tables include Nanda's the upper 1% and 5% points for s = 2, m = 0($\frac{1}{2}$)2, n = $\frac{1}{2}$($\frac{1}{2}$)10; Chaudhuri's, the upper 1% and 5% points for s = 2, m = n = 2$\frac{1}{2}$($\frac{1}{2}$)5(1)11, for s = 3, m = n = 2$\frac{1}{2}$($\frac{1}{2}$)5(1)8, and for s = 3, m = 0($\frac{1}{2}$)2, n = $\frac{1}{2}$($\frac{1}{2}$)2,

Foster and Rees, the upper 1%, 5%, 10%, 15%, and 20% points for s = 2, m = -½, 0(1)9 n = 1(1) 19(5)49, 59, 79; and Foster's the upper 1%, 5%, 10%, 15%, and 20% points for s = 3, 4, m = -½(½)3, n = 0(1)95.

1857

North Carolina U. [Inst. of Statistics] Chapel Hill.

FURTHER RESULTS ON THE CONSTRUCTION OF MUTUALLY ORTHOGONAL LATIN SQUARES AND THE FALSITY OF EULER'S CONJECTURE, by R. C. Bose, S. S. Shrikhande, and E. T. Parker. [1959] [15]p. incl. tables, refs. (AF 49(638)213) Unclassified

Published in Canad. Jour. Math., v. 12: 189-203, 1960.

Better bounds on N(v), the maximum possible number of mutually orthogonal Latin squares of order v, are obtained by improving Euler's main theorem. The method of conjecture is used to show that N(v) ≥ 2 when v = 14, 26, or 12t + 10, and Euler's conjecture is shown to be false for all v = 4t + 2 > 6.

1858

North Carolina U. [Inst. of Statistics] Chapel Hill.

ON THE MONOTONIC CHARACTER OF THE POWER FUNCTIONS OF TWO MULTIVARIATE TESTS, by S. N. Roy and W. F. Mikhail. [1959] [7]p. (AF 49-(638)213) Unclassified

Published in Ann. Math. Stat., v. 32: 1145-1151, Dec. 1961.

It is shown that the power function in 2 multivariate tests is a monotonically increasing function of each non-centrality parameter, separately. The proof of this property is given and it is shown how this proof may be modified for testing independence between 2 sets of variates. (Contractor's abstract)

1859

North Carolina U. [Inst.] of Statistics, Chapel Hill.

EVALUATION OF DETERMINANTS, CHARACTERISTIC EQUATIONS AND THEIR ROOTS FOR A CLASS OF PATTERNED MATRICES, by S. N. Roy, G. B. Greenberg, and A. E. Sarhan. Dec. 1959, 27p. (AFOSR-TN-60-200) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)213 and Office of Ordnance Research as technical rept. no. 10 under DA 36-034-ORD-2184) AD 231755; PB 145994 Unclassified

Also published in Jour. Roy. Statist. Soc., Series B, v. 22: 348-349, 1960.

The evaluation of determinants, characteristic equations, and characteristic roots for a class of specially structured matrices is studied. Various methods and transformations are shown. The operations are mathematically related to the inversion process and are often required by fields such as analysis of variance, response surface fitting and multivariate analysis, and on data under various types of models, "normal" and "non-normal."

1860

North Carolina U. Inst. of Statistics, Chapel Hill.

ON CERTAIN ALTERNATIVE HYPOTHESES ON DISPERSION MATRICES, by S. N. Roy and R. Gnanadesikan. Aug. 1960, 18p. incl. refs. (Mimeograph series no. 261) (AFOSR-TN-60-984) (AF 49(638)213) AD 248657; PB 153831 Unclassified

For 2 multivariate nonsingular normal distributions, the familiar null hypothesis of equal dispersion matrices is considered against various alternatives stated in terms of certain characteristic roots. Based on 2 independent random samples from the 2 distributions, similar region tests are proposed for the null hypothesis against each of the alternative hypotheses. Also, for each case, conservative confidence bounds are obtained for 1 or more parametric functions which measure departure from the null hypothesis in the direction of the corresponding alternative. Finally, a physical interpretation is given for the alternative hypotheses considered. (Contractor's abstract)

1861

North Carolina U. Inst. of Statistics, Chapel Hill.

ON A NEW DERIVATION OF A WELL KNOWN DISTRIBUTION, by S. N. Roy. Apr. 1960 [11]p. (Mimeograph series no. 254) (AFOSR-TN-60-985) (AF 49-(638)213) PB 153832 Unclassified

It is well known that so far the joint distribution of the latent roots associated with normal multivariate analysis of variance has been considerably more difficult to derive if the effective number of variates is greater than the number of components of the linear hypothesis than if it is the other way around. This report offers both on the null and non-null hypothesis a simple method of derivation of the distribution for the former case by throwing it back on the distribution for the latter case, and in this tie-up a pivotal role is played by the distribution of the latent roots connected with the testing of the hypothesis of independence between 2 sets of variates. (Contractor's abstract)

1862

North Carolina U. Inst. of Statistics, Chapel Hill.

ON SOME METHODS OF CONSTRUCTION OF PARTIALLY BALANCED ARRAYS, by I. M. Chakravarti. May 1960, 9p. incl. tables. (Mimeograph series no. 260) (AFOSR-TN-60-1019) (AF 49(638)213) AD 248656; PB 153834 Unclassified

Also published in Ann. Math. Stat., v. 32: 1181-1185, Dec. 1961.

Methods of construction of partially balanced arrays are considered. Two methods of construction are given. One of them derives partially balanced arrays from (λ-μ-ν) configurations, and the other is an extension of Bose-Shrikhande method of construction of orthogonal arrays. (Contractor's abstract)

1863

North Carolina U. [Inst.] of Statistics, Chapel Hill.

ON SOME CONNECTIONS BETWEEN THE DESIGN OF EXPERIMENTS AND INFORMATION THEORY, by R. C. Bose. [1960] [30]p. (AFOSR-83) (In cooperation with Case Inst. of Tech., Cleveland, Ohio as its Computing Center publ. no. 1022) (AF 49(638)213) AD 251169 Unclassified

Also published in Bull. Inst. Internat'l. Stat., v. 38: 257-271, 1961.

An analysis was conducted to bring out the interconnection between the theory of confounding and fractional replication and the theory of error-correcting codes. It is shown that the problem of determining the alphabet of the code or the fundamental subgroup of the design can be reduced to the same problem, viz., the packing problem. This is the problem of finding the maximum possible number of distinct points in the finite projective space PG(r-1, s), where s is a prime power, so that no d of the points are dependent. (Contractor's abstract)

1864

North Carolina U. [Inst. of Statistics] Chapel Hill.

ON METHODS OF CONSTRUCTING SETS OF MUTUALLY ORTHOGONAL LATIN SQUARES USING A COMPUTER. 1., by R. C. Bose, I. M. Chakravarti, and D. E. Knuth. [1960] [20]p. incl. tables, refs. (AFOSR-84) (In cooperation with Case Inst. of Tech., Cleveland, Ohio as its Statistical Lab. publ. no. 1024) (AF 49(638)213) AD 251134 Unclassified

Also published in Technometrics, v. 2: 507-516, Nov. 1960.

A method of searching for mutually orthogonal Latin squares of order 4t (with the help of computer) was developed, using the concept of orthogonal mappings of a group G into itself. It was shown that the existence of s orthogonal mappings of a group of order 4t implies the existence of s mutually orthogonal Latin squares of order 4t. Taking G to be the abelian group of order 12 whose elements are vectors (a, b), and the addition is mod (2, 6), a search for orthogonal mappings was conducted with the help of a computer. Two sets of 5 mutually orthogonal mappings were discovered, giving sets of 5 mutually orthogonal Latin squares of order 12.

1865

North Carolina U. [Inst. of Statistics] Chapel Hill.

FURTHER RESULTS ON ERROR CORRECTING BINARY GROUP CODES, by R. C. Bose and D. K. Ray-Chaudhuri. [1960] [17]p. incl. tables. (AFOSR-85) (In cooperation with Case Inst. of Tech., Cleveland, Ohio as its Computing Center publ. no. 1020) (AF 49-(638)213) AD 251137 Unclassified

Also published in Inform. and Control, v. 3: 279-290, 1960.

A method of constructing a t-error correcting code with n places is given for any arbitrary n and $k = n - R(m,t) \geq [(2^m - 1)/c] - mt$ information places where m is the least integer such that $cn = 2^m - 1$ for some integer c. A second method of constructing t-error correcting codes for n places when n is not of the form $2^m - 1$ is also given. (Supplement to item no. 1403, Vol. III)

1866

North Carolina U. Inst. of Statistics, Chapel Hill.

THEOREMS IN THE ADDITIVE THEORY OF NUMBERS, by R. C. Bose and S. Chowla. Nov. 1960, 9p. (Mimeograph series no. 269) (AFOSR-86) (AF 49(638)213) Unclassified

Also published in Comment. Math. Helv., v. 37: 141-147, 1962.

If $m = p^n$ (where p is a prime), m non-zero integers (numerically less than m^r) $d_1 = 1, d_2, \ldots d_m$, can be found such that the sums $d_{i_1} + d_{i_2} + \ldots d_{i_r}$ ($1 \leq i_1 \leq \ldots \leq i_r \leq m$) are all different mod $(m^r - 1)$. A B_r-sequence is defined as a system of integers $d_1, d_2, \ldots d_k$ such that the sums $d_{i_1} + d_{i_2} + \ldots d_{i_r}$ ($i_1 \leq i_2 \leq \ldots \leq i_r$) are all different. If $F_r(x)$ denotes the maximum number of members a B_r-sequence can have when no member exceeds x, then $\liminf \{F_r(x) x^{-1/r}\} \geq 1$ as $x \to \infty$.

1867

North Carolina U. Inst. of Statistics, Chapel Hill.

CONFIDENCE BOUNDS CONNECTED WITH ANOVA AND MANOVA FOR BALANCED AND PARTIALLY BALANCED INCOMPLETE BLOCK DESIGNS, by V. P. Bhapkar. [1960] [8]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)213 and Office of Naval Research under Nonr-85506) Unclassified

Published in Ann. Math. Stat., v. 31: 741-748, Sept. 1960.

For both ANOVA (analysis of variance) and MANOVA (multivariate analysis of variance), the hypothesis considered is that of equality of the treatment effects-vector equality in the case of MANOVA. Starting from such a hypothesis, explicit algebraic expressions are obtained

for the total and parametric functions that go with the simultaneous confidence statements in the case of both ANOVA and MANOVA and for balanced and partially balanced designs. A method for obtaining the algebraic expression for the confidence bounds on each such parametric form is also given. (Contractor's abstract)

1868

North Carolina U. [Inst. of Statistics] Chapel Hill.

MIXED MODEL VARIANCE ANALYSIS WITH NORMAL ERROR AND POSSIBLY NON-NORMAL OTHER RANDOM EFFECTS. I. THE UNIVARIATE CASE, by S. N. Roy and W. Cobb. [1960] [19]p. incl. refs. [AF 49(638)213] Unclassified

Published in Ann. Math. Stat., v. 31: 939-957, Dec. 1960.

An approximation of its unknown distribution is made by replacing the stochastic variate (unobservable) by a substitute variate which is supposed to take 2, 3, or in general, k values with equal probabilities. An attempt is then made to estimate these unknown values, k, which may be regarded as approximations to the first, third, ..., (2k-1)th quantiles of the unknown distribution. It is also shown how the usual inference about the fixed effects can be made and how certain types of confidence bounds can be found for each of several random-effects factors in an experiment with orthogonal design.

1869

North Carolina U. [Inst. of Statistics] Chapel Hill.

MIXED MODEL VARIANCE ANALYSIS WITH NORMAL ERROR AND POSSIBLY NON-NORMAL OTHER RANDOM EFFECTS. II. THE MULTIVARIATE CASE, by S. N. Roy and W. Cobb. [1960] [11]p. [AF 49(638)-213] Unclassified

Published in Ann. Math. Stat., v. 31: 958-968, Dec. 1960.

Confidence bounds are obtained on the maximum and minimum characteristic roots of the variance matrix of the block effects when the latter are assumed to come from a p-variate normal distribution. When the random block effects are not assumed to be normal, consideration is given to the approximation of an unknown multivariate distribution by means of marginal and conditional quantiles. Simultaneous confidence bounds are found for the 2 interquartile ranges for the bivariate case. (Contractor's abstract)

1870

North Carolina U. [Inst. of Statistics] Chapel Hill.

SOME TESTS FOR CATEGORICAL DATA, by V. P. Bhapkar. [1960] [12]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)213 and Office of Naval Research under Nonr-85506) Unclassified

Published in Ann. Math. Stat., v. 32: 72-83, Mar. 1961.

Experimental data are supposed given as frequencies n_{ij} in the cells of a multiway cross-classification where the probability of an occurrence in cell$_{ij}$ is p_{ij} $\Sigma_1 p_{ij} = 1$, and $\Sigma_1 n_{ij} = n_{oj}$ is held fixed. An explicit expression is found for the minimum of the statistic $\chi_1^2 = \Sigma_{1j} (n_{ij} - n_{oj} \hat{p}_{ij})^2 / n_{ij}$, where the caret denotes a BAN estimate under the hypothesis $\Sigma_{ij} f_{ij} p_{ij} th_t = 0$ (t = 1, 2, ..., m), where the f's and h's are supposed known. Other forms of the result are given and some particular cases are provided.

1871

North Carolina U. Inst. of Statistics, Chapel Hill.

THE ASYMPTOTIC POWER OF THE KOLMOGOROV TESTS OF GOODNESS OF FIT, by D. Quade. Dec. 1959, 95p. incl. diagrs. tables, refs. (Mimeograph series no. 243) (AFOSR-TN-60-55) (AF 49(638)261) AD 235096 Unclassified

Let there be a random sample of size n from some unknown distribution function F(x), let $F_n(x)$ be the empirical distribution function of the sample, and let H(x) be the null-hypothesis distribution. Then the 1-sided Kolmogorov test rejects H(x) for large values of $D_n^+ = \sup_x \sqrt{n} [F_n(x) - H(x)]$, and the 2-sided Kolmogorov test rejects H(x) for large values of $D_n = \sup_x \sqrt{n} |F_n(x) - H(x)|$. The asymptotic power of these tests are investigated against sequences of alternatives $G_n(x)$ for which $\lim_{n \to \infty} \sup_x \sqrt{n} |H(x) - G_n(x)|$ exists. Donsker's justification of Doob's heuristic procedure as applied to this problem is extended. Upper and lower bounds on the asymptotic power are found. Numerical examples are illustrated for the case where $G_n(x)$ consists in a translation of H(x). (Contractor's abstract)

1872

North Carolina U. Inst. of Statistics, Chapel Hill.

ON SEQUENCES OF SUMS OF INDEPENDENT RANDOM VECTORS, by W. Hoeffding. May 1960, 24p. (Mimeograph series no. 258) (AFOSR-TN-60-987) (AF 49(638)261) AD 248655; PB 153833 Unclassified

Also published in Proc. Fourth Berkeley Symposium on Mathematical Statistics and Probability, California U., Berkeley (June 20-July 30, 1960), Los Angeles, California U. Press, 1961, v. 2: 213-226. (AFOSR-2135)

A particle in k-space starts at the origin and after n time units is at S_n, where S_n is the sum of n independent, identically distributed random vectors with integer-valued components zero means, and non-singular second-moment matrix. A time-dependent absorption boundary is present such that the expected time to absorption is finite. A relation is established between the expected number of times the particle is at the origin prior to absorption and its expected distance from the origin at the time of absorption. (Contractor's abstract)

1873

North Carolina U. Inst. of Statistics, Chapel Hill.

BAYES RULES FOR A COMMON MULTIPLE COMPARISONS PROBLEM AND RELATED STUDENT-t PROBLEMS, by D. B. Duncan. Nov. 1960, 35p. incl. tables, refs. (Mimeograph series no. 268) (AFOSR-TN-60-1418) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)261 and AF 49-(638)929, Office of Naval Research under Nonr-35506, and Public Health Service) AD 248659; PB 153840 Unclassified

Also published in Ann. Math. Stat., v. 32: 1013-1033, Dec. 1961.

The following multiple comparisons problem in the analysis of variance setting is considered. In a balanced experiment, n treatments are to be compared. Each of the n(n-1)/2 pairwise comparisons is made, adjudging each difference as positive, negative, or not significant; overall decisions involving intransitivities are barred. The loss for each difference is proportional to the error; if a difference is asserted incorrectly the loss has proportionality constant if not-significant is the (incorrect) conclusion. Total loss for the experiment is taken as the sum of the n(n-1)/2 component losses. The Bayes rule is shown to consist in the simultaneous application of Bayes rules to the n(n-1/2 component problems. Each of these is shown to consist in the simultaneous application of Bayes rules to 2 subcomponent problems into which each can be further decomposed. The subcomponent Bayes rule for a normal prior density of treatment means is explicitly derived. The dependencies of the solution on the variance of the prior density, the degrees of freedom and the loss ratio are discussed. A principal finding is that the Bayes solution for the multiple comparisons problem corresponds to a tolerated error probability of the first kind for each single difference, which is independent of the number of treatments being compared. (see also Item no. 1412, Vol. III) (Contractor's abstract)

1874

[North Carolina U. Inst. of Statistics, Chapel Hill]

ESTIMATORS WITH MINIMUM BIAS, by W. J. Hall. [1960] [33]p. incl. diagrs. tables, refs. (AF 49(638)-261) Unclassified

Published in Mathematical Optimization Techniques; a Symposium, Santa Monica, Calif. (Oct. 18-20, 1960), Berkeley and Los Angeles, California U. Press, 1963, p. 167-199.

A theory of minimum-bias estimation is discussed which is considered to be completely parallel to the minimum-risk theory and applicable whenever unbiased estimators do not exist. The minimum-risk theory is first reviewed and the role of bias therein reinterpreted. A minimum-bias theory is next introduced, paralleling the risk theory, with the role of risk function replaced by a bias function (i.e. absolute, squared, or percentage of absolute bias) Thus, estimators that minimize the average or maximum of the bias function are introduced. Relevant aspects of the theory of approximation, in the Chebyshev and least-squares senses, are reviewed, and results bearing considerable conceptual similarity to Wald's results on minimax and Bayes estimators are thereby derived. Finally, an example is presented and a variety of minimum-bias and minimum-risk estimators are derived and compared.

1875

North Carolina U. [Psychometric Lab.] Chapel Hill.

PERCENTAGE ESTIMATION OF PROPORTION AS A FUNCTION OF ELEMENT TYPE, EXPOSURE TIME, AND TASK, by E. H. Shuford. [1960] [7]p. incl. illus. diagrs. (AFOSR-TN-60-872) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-729 and Air Force Personnel and Training Research Center) Unclassified

Also published in Jour. Exper. Psychol., v. 61: 430-436, May 1961.

Two experiments were conducted in order to investigate the effect of element type, exposure time, and task on the percentage estimation of proportion. The stimuli were photographs of 20 x 20 matrices made up of randomly arranged red and blue squares of vertical and horizontal bars. When subjects estimated the percentage of elements of the type specified by E, they overestimated the proportion of red squares and of horizontal bars relative to the proportion of blue squares and vertical bars. The amount of this bias was smaller for the longer exposure time and for the more extreme proportions. The observed relations between mean response and proportion were S-shaped. When subjects estimated the percentage of elements of the more frequent or less frequent type, the proportion of red squares and of horizontal bars was again overestimated, but the ogival nature of the relation between mean response and proportion was absent. The results are interpreted in terms of a hypothetical sampling process and various response biases. (Contractor's abstract)

1876

North Carolina U. [Psychometric Lab.] Chapel Hill.

A RATIONAL ORIGIN OBTAINED BY THE METHOD OF CONTINGENT PAIRED COMPARISONS, by E. H.

Shuford, L. V. Jones, and R. D. Bock. [1960] [14]p. incl. diagrs. tables, refs. (AFOSR-TN-60-922) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)729 and Quartermaster Research and Engineering Command under DA 19-129-QM-1045) AD 250702 Unclassified

Also published in Psychometrika, v. 25: 343-356, Dec. 1960.

A new paired comparison method, based upon choices between lotteries, is developed for the measurement of utilities of objects with respect to the utility of receiving nothing, i.e., the status quo. The method is used to estimate the utilities of 4 birthday gifts. These objects have also been studied in an earlier experiment (Jour. Amer. Stat. Assoc., v. 52: 458-471, 1957) which used choices between single objects and pairs of objects to determine a rational origin. A comparison of the results of the 2 experiments indicates that both methods scale objects with respect to the same rational origin and unit of measurement. (Contractor's abstract)

1877

North Carolina U. Psychometric Lab., Chapel Hill.

THE PREDICTION OF CHOICE UNDER TWO MODELS FOR CONTINGENT AND COMPOUND PAIRED COMPARISONS, by J. J. McKeon, E. H. Shuford, and R. D. Bock. Oct. 1960, 5p. incl. table. (AFOSR-TN-60-1308) (AF 49(638)729) AD 250705 Unclassified

Presented at annual meeting of the Psychometric Soc. and American Psychological Assoc., Chicago, Ill., Sept. 7, 1960.

S. S. Stevens has distinguished between 2 types of psychological scales which he has called metathetic and prothetic. The idea that utility is a prothetic quantity and that paired comparisons or successive intervals methods may give inaccurate information when used in utility measurement is presented. Unless the coefficient of variation for utilities is more stable than seems likely, direct ratio estimation or the related group of probability-weighting procedures will probably give better results in utility measurement than paired comparisons or successive intervals. (Contractor's abstract)

1878

Northeastern U. Dept. of Physics, Boston, Mass.

NORMAL-MODE TREATMENT OF PINCH INSTABILITIES, by J. Sullivan. May 1960, 75p. incl. diagrs. tables, refs. (AFOSR-TN-60-1146) (AF 49(638)555) AD 250065 Unclassified

An elementary discussion is given of the phenomenon of the pinch effect and the 2 most common modes of instability to which it is susceptible. A mathematical study is presented of the instabilities arising when a cylinder of plasma of infinite conductivity experiences the pinch effect. The technique used is the normal-mode treatment of small perturbations. The next section includes the effect on the instabilities of including an axial magnetic field within the plasma. Finally the effect of a conducting surface on the stabilization of the sausage and kink type instabilities is given. The treatment shows that the kink instability is stabilized only for small perturbation wave-numbers.

1879

Northeastern U. Dept. of Physics, Boston, Mass.

MAGNETOHYDRODYNAMIC SHOCK WAVES, by J. Davis. May 1960, 53p. incl. refs. (AFOSR-TN-60-1147) (AF 49(638)555) AD 262443 Unclassified

Aspects of non-relativistic magnetohydrodynamics for a compressible fluid are discussed. Basic parameters such as entropy, enthalpy, specific heat, etc., are defined and the fundamental equations set up describing the thermodynamics of fluid flow. An immediate result of these equations is the magnetic analogue of the Rayleigh and Fanno lines. It is further shown that the entropy and the specific heat at constant volume are unaltered by the presence of the magnetic field. In observing the non-relativistic propagation of a plane perpendicular magnetohydrodynamic shock wave, it was seen that a magnetic field is conducive to the growth of the compression waves and accelerates the decay of expansion waves. It is also shown that along a Hugonoit surface the entropy change is of the third order in the difference of specific volume or of pressure across the shock front, and that a magnetohydrodynamic shock wave reduces, in the limit, to an ordinary sound wave. The last part investigates the effect of thermal diffusion on the non-relativistic propagation of plane normal magnetohydrodynamic shock wave in a mixture of 2 completely ionized gases. The results are: (1) the thermal diffusion is likely to cause large variations in density across a magnetohydrodynamic shock front; (2) the presence of a transverse magnetic field lowers the upper limit and raises the lower limit of the compression coefficient.

1880

Northeastern U. Dept. of Physics, Boston, Mass.

ELECTROMAGNETIC THEORY NOTES, by G. Lanza. [1960] 114p. incl. diagrs. (AF 49(638)555) Unclassified

The notes for an electromagnetic theory course are presented. The subject matter includes potential theory for non-conductors, harmonic functions, electrostatic field with conductors, dielectrics, systems of conductors, magnetostatics, and electromagnetism.

1881

Northwestern U., Evanston, Ill.

PROCEEDINGS OF THE THIRD BIENNIAL GAS DYNAMICS SYMPOSIUM ON DYNAMICS OF CONDUCTING

GASES, Evanston, Ill., Aug. 24-26, 1959, ed. by A. B. Cambel and J. B. Fenn. Evanston, Northwestern U. Press, Mar. 1960, 212p. incl. illus. diagrs. tables, refs. (AFOSR-TR-60-87) (In cooperation with Amer. Rocket Soc.) (Sponsored jointly by Air Force Office of Scientific Research, National Aeronautics and Space Administration, Office of Naval Research (Project Squid), and Office of Ordnance Research)
Unclassified

This volume contains 18 papers and lectures presented at the 1959 Symposium. The volume is arranged into several parts, namely Part I: Elementary Processes and Properties in Ionized Gases, Part II: Theoretical Considerations on the Interaction of Magnetic Fields and Flow of Ionized Gases, Part III: Laboratory Experience with Ionized Gas Flow, and Part IV: Applications of Magneto-Gasdynamic Effects.

1882

Northwestern U. Dept. of Chemistry, Evanston, Ill.

SYNTHESIS AND CHARACTERIZATION OF CIS AND TRANS-DICHLOROBIS-(ETHYLENEDIAMINE)RHODIUM(III) SALTS, by S. Anderson and F. Basolo. [1960] [2]p. (AFOSR-TN-60-988) (AF 49(638)315) AD 427955
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 4423-4424, Aug. 20, 1960.

The synthesis and characterization of cis- and trans-$[Rh(en)_2Cl_2]^+$ salts (en = $NH_2CH_2CH_2NH_2$) are reported. The cis- and trans-$[Rh(en)_2Cl_2]NO_3$ were isolated from a reaction mixture obtained by gradually adding aqueous KOH to a refluxing water solution of $RhCl_3 \cdot 3H_2O$ and en·2HCl. Although the chloride salts are fairly soluble, it is possible to isolate cis- and trans-$[Rh(en)_2Cl_2]Cl$ from a subsequent reaction mixture. The first crystals to separate are the cis isomer after which the more soluble trans form is obtained from the mother liquor. Assignment of the geometric configuration to the 2 isomers was made on the basis of the resolution of the asymmetric cis isomer. Additional evidence in support of this structural assignment is offered by a comparison of the rhodium(III) isomers with the same cobalt(III) compounds of known structure.

1883

Northwestern U. [Dept. of Chemistry] Evanston, Ill.

CHLOROAMMINERHODIUM(III) SALTS, by S. N. Anderson and F. Basolo. [1960] 5p. (AFOSR-TN-60-1209) (AF 49(638)315)
Unclassified

Methods for the synthesis of hydrated rhodium chloride ($RhCl_3 \cdot 3H_2O$) are analyzed. Anhydrous $RhCl_3$ may be obtained directly from the elements, but here a somewhat more circuitous route is utilized. The methods and reactions producing chloroamminerhodium(III) salts, such as chloropentamminerhodium(III) chloride, trans-dichlorotetramminerhodium(III) chloride, and bis- and trans-dichloro-bis(ethylenediamine) rhodium(III) nitrate are given. Means of recovering rhodium wastes are described.

1884

Northwestern U. Dept. of Chemistry, Evanston, Ill.

LINKAGE ISOMERISM: SYNTHESIS AND ISOMERIZATION OF NITRITOPENTAMMINE COMPLEXES OF RHODIUM(III) AND IRIDIUM(III), by F. Basolo and G. S. Hammaker. [1960] [2]p. (AFOSR-5490) (AF 49-(638)315)
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 1001-1002, Feb. 20, 1960.

For Abstract See item no. 1413, Vol. III.

1885

Northwestern U. Dept. of Chemistry, Evanston, Ill.

HYDROGENATION OF 3,3-DIMETHYL-1,4-PENTADIENE ON NICKEL CATALYSTS. A TEST OF THE DEGREE OF DIFFUSIONAL CONTROL IN CATALYTIC HYDROGENATIONS, by R. Ciola and R. L. Burwell, Jr. [1960] [6]p. incl. diagrs. tabie, refs. (AFOSR-1871) [AF 49(638)935]
Unclassified

Also published in Jour. Phys. Chem., v. 65: 1158-1163, July 1961.

On nickel wire and on nickel-silica cataiysts in the vapor phase and on nickel-siiica in the iiquid phase, the two double bonds of 3,3-dimethyi-1,4-pentadiene appear to hydrogenate independentiy. In the absence of diffusionai controi, 3,3-dimethylpentene is the only initial product. If substantial concentration gradients in the cataiyst pores lead to diffusionai control, 3,3-dimethylpentane appears as an apparent initiai product and its initiai ratio to dimethyipentene constitutes a measure of the degree of diffusional controi introduced by hydrocarbon concentration gradients. Under the conditions employed in the vapor phase reaction, such gradients were smaii or negiigibie for oxidized nickei wire, large on 40-60 mesh nickei-silica and stiil larger on 20-40 mesh nickei-silica. In the iiquid phase at room temperature on 100-200 mesh nickei-siiica, the concentration gradients of oiefin were smaii but those of hydrogen appeared to introduce a serious degree of diffusional limitation. In the iiquid phase, the ratio of the rate constants of hydrogenation of the diene and of the mono-ene was about 9 and the ratio of 3,3-dimethyibutene and 3,3-dimethyipentene was 1.6. On the assumption that the kinetic forms for the rates of hydrogenation of diene and mono-ene are identical, a kinetic treatment of the course of hydrogenation is derived as a function of the initial ratio of mono-ene to aikane. (Contractor's abstract)

1886

Northwestern U. [Dept. of Mathematics] Evanston, Ill.

CONVOLUTIONS AND GENERAL TRANSFORMS ON L^p, by R. R. Goldberg. [1959] [9]p. (AF 49(638)383) Unclassified

Published in Duke Math. Jour., v. 27: 251-259, 1960.

In a recent paper (Item no. NOR. 09:002, Vol. II), the author has generalized a result of Titchmarsh to show that if f and g are a pair of cosine transforms in L^2, then so are $F(x) = \int_0^\infty \frac{1}{y}\,\varphi\left(\frac{x}{y}\right) f(y)\,dy$ and $G(y) = \frac{1}{y}\int_0^\infty \varphi\left(\frac{x}{y}\right) g(x)\,dx$. Here φ is any non-negative function satisfying $\int_0^\infty \varphi(y) y^{-1/2}\,dy < \infty$. (The result of Titchmarsh is the special case $\varphi(x) = 1$ $(0 \le x \le 1)$, $\varphi(x) = 0$ $(1 < x < \infty)$). One object of the present paper is to show that the generalized result applies not only to the cosine transform but to any Watson transform (and indeed to a more general class of transforms). Use is made of a theorem of Schur concerning integral transforms with kernels homogeneous of degree -1. The first part of the paper is devoted to a demonstration of a theorem concerning functions on n-dimensional space which reduces to the theorem of Schur when n = 1. This n-dimensional theorem is obtained by first constructing an isomorphism between L^p spaces on all of n-space and certain spaces of functions defined on the set of n-tuples with positive coordinates and then applying a well-known result concerning L^p spaces on arbitrary locally compact Abelian groups. Thus Schur's classical result is put in a group theoretic setting. Finally, making use of the isomorphism mentioned above, together with the author's result on Watson transforms, the theorem of Bochner and Chandrasekharan is deduced, which states that every Watson transform is the product of a certain elementary Watson transform and a unitary operator which (when considered as acting on $L^2(-\infty, \infty)$) commutes with translations.

1887

Northwestern U. [Dept. of Mathematics] Evanston, Ill.

AN INTEGRAL TRANSFORM RELATED TO THE HILBERT TRANSFORM, by R. R. Goldberg. Mar. 1960, 6p. (AFOSR-TN-60-197) (AF 49(638)383) AD 233956; PB 146418 Unclassified

Also published in Jour. London Math. Soc., v. 35: 200-204, 1960.

The following basic results are established concerning the transform $f^*(x) = \frac{1}{\pi}\int_0^\infty \frac{f(x+t) - f(x-t)}{t} \cdot \frac{\sin t}{t}\,dt$ for arbitrary $f \in L^2$: an inversion formula, an explicit expression for f^* in terms of the Hilbert transform of f, an explicit expression for the Hilbert transform of f in terms of f^*, and an expression for f^{**} in terms of f.

1888

Northwestern U. [Dept. of Mathematics] Evanston, Ill.

WATSON TRANSFORMS ON GROUPS, by R. R. Goldberg. Mar. 1960, 7p. (AFOSR-TN-60-198) (AF 49(638)383) AD 233957; PB 146417 Unclassified

Also published in Ann. Math., v. 71: 522-528, 1960.

The theory of general transforms on $L^2(0, \infty)$ is extended to groups. If G is any locally compact abelian group then, on $L^2(G)$, a set of integral transforms is constructed each of which gives rise to a unitary transformation on $L^2(G)$. With appropriate specialization these integral transforms become the classical Watson transforms.

1889

Northwestern U. [Dept. of Mathematics] Evanston, Ill.

SYMMETRY IN MEASURE ALGEBRAS, by A. B. Simon. [1960] [2]p. (AF 49(638)383) Unclassified

Published in Bull. Amer. Math. Soc., v. 66: 399-400, Sept. 1960.

An affirmative answer is provided for Rudin's question: Is there a set larger than the closure of Γ on which the Gelfand transforms are symmetric (Bull. Amer. Math. Soc., v. 65: 227-247, 1959). The answer is dependent upon whether G is a real line. Assuming the above to be so, the algebra M(G) of all regular Borel measures with convolution as multiplication is considered. The result is shown in a brief proof.

1890

Northwestern U. [Dept. of Mathematics] Evanston, Ill.

HOMOMORPHISMS OF MEASURE ALGEBRAS, by A. B. Simon. [1960] [11]p. [AF 49(638)383] Unclassified

Published in Ill. Jour. Math., v. 5: 398-408, Sept. 1961.

Let M_0 be the algebra generated by M(Pu - P), the linear subspace of measures concentrated on (Pu - P), and all the discrete measures. Then let M_1 be the algebra consisting of all those measures which are absolutely continuous to some element of M_0. Let h = L (L is any linear functional) on M(Pu - P) and extend h to M_1 making use of Šreider's "generalized functions". After proving h is well defined and is a homomorphism on M_1, h is extended to be a homomorphism on the closure of M of M_1. It is also shown that the orthogonal complement $M^\perp$ of M is an ideal and M(G) (G is the measured algebra) is the direct sum of M and $M^\perp$

1891

Northwestern U. Dept. of Mathematics, Evanston, Ill.

FLUCTUATION THEORY FOR INTEGER-VALUED RANDOM VARIABLES, by M. Dwass. Sept. 1, 1960, 13p. (AFOSR-TN-60-1036) (AF 49(638)877) AD 243194 Unclassified

If $X_I, \ldots, X_{II}$ are non-negative, integer-valued, and interchangeable random variables, then $P(S_m < m, m = 1, \ldots, N) = E(N-S_N)^+$. This theorem is used to derive the distributions of $\max_m (m - S_m)$ and $\max_m (S_m - m)$, $(S_o = 0)$, where the maximum is taken over $0, 1, \ldots, N$ or over $0, 1, \ldots,$ ad inf. Some of the results require independence. Applications are made to suprema of infinitely divisible processes. (Contractor's abstract)

1892

Northwestern U. Dept. of Mathematics, Evanston, Ill.

STARLIKE HYPERGEOMETRIC FUNCTIONS, by E. P. Merkes and W. T. Scott. Dec. 1960 [4]p. (Technical rept. no. 1) (AFOSR-14) (In cooperation with Marquette U., Milwaukee, Wis.) (AF 49(638)888) AD 249813 Unclassified

Also published in Proc. Amer. Math. Soc., v. 12: 885-888, Dec. 1961.

It is shown that, if $0 < a < c$ and $-1 < b \leq a$, the function is defined in terms of the hypergeometric function F by $u(z) = zF(a, b, c; z)$ is univalent and starlike with respect to the origin for $|z| < \rho$, where ρ is $1/(1-b)$, 1 or $1/(b-1)$, according as $-1 < b < 0$, $0 \leq b \leq 2$ or $b \leq 2$, respectively. The proof is accomplished by means of known inequalities for functions having certain kinds of continued fraction representations. As a corollary, a condition on a, b, c and r is given which is sufficient for $F(a, b, c; z)$ to be univalent for $|z| < r$ and map this domain onto a convex domain. (Math. Rev. abstract)

1893

Northwestern U. [Dept. of Medicine] Chicago, Ill.

DIRECT ION-EXCHANGE CHROMATOGRAPHY OF TISSUE EXTRACTS WITHOUT PRECIPITATION OF PROTEIN BY USE OF NON-IONIC DETERGENTS, by R. M. Dowben, E. Venturini and others. [1960] [4]p. incl. diagrs. (AFOSR-TN-60-246, pt. 1) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)321, Muscular Dystrophy Associations of America and National Institutes of Health) AD 247688 Unclassified

Also published in Biochim. et Biophys. Acta, v. 43: 338-341, 1960.

The separation of constituents of a biological preparation by ion-exchange chromatography is done with protein free filtrates because protein adheres to ion-exchange resins and clogs the columns. By adding certain polyoxyethylene non-ionic detergents, it was found that direct chromatography could be done without precipitation of proteins. The proteins did not adhere to the resins but flowed through the columns directly. This method is applicable to all substances of low molecular weight.

1894

Northwestern U. Dept. of Medicine, Chicago, Ill.

MODIFIED RESIN METHOD FOR DETERMINATION OF RADIOIODINE CONVERSION RATIO, by R. M. Dowben. [1960] [4]p. incl. diagr. tables. (AFOSR-TN-60-246, pt. 2) (AF 49(638)321) AD 247689 Unclassified

Also published in Jour. Lab. and Clin. Med., v. 55: 132-135, Jan. 1960.

A modified ion-exchange resin method for the determination of the radio-iodine conversion ratio is described which utilizes a non-ionic detergent to prevent the binding of protein by ion-exchange resins. The method is simple to perform and overcomes the disadvantages of other methods. Results of studies in 58 patients are reported. (Contractor's abstract)

1895

Northwestern U. Dept. of Metallurgy [and Materials Science] Evanston, Ill.

X-RAY SMALL ANGLE SCATTERING FROM GUINIER-PRESTON ZONES IN DEFORMED ALUMINUM-SILVER SINGLE CRYSTALS, by S. Sato and A. Kelly. [1960] [3]p. incl. diagrs. table, refs. (AFOSR-4027) (AF 18-(600)1468) Unclassified

Also published in Acta Metall., v. 9: 59-61, Jan. 1961.

Aluminum-silver alloy single crystals containing 20 wt% silver were quenched from the δ-phase field and aged at room temperature. Under these conditions 10-20% of the alloy consists of zones each containing a spherical silver rich cluster of atoms surrounded by a shell of material containing very little silver. Recent theories of the strength of these alloys predict that large numbers of dislocations pass through the spherical clusters when the crystals are deformed. This paper investigates the change in symmetry of the x-ray small angle scattering pattern when single crystal patterns are deformed in tension. For most crystals 2 directions at right angles were chosen to measure the scattering such that the scattering vector in reciprocal space lay in the plane of the sheet. The results show that the silver rich clusters do deform with the matrix in single crystals deformed in tension. The deformation of the clusters is closely the same as that of the crystals as a whole.

1896

Northwestern U. [Dept. of Metallurgy and Materials Science] Evanston, Ill.

GRAIN BOUNDARY SLIDING VERSUS GRAIN BOUNDARY

MIGRATION IN CREEP, by J. O. Brittain and N. R. Adsit. Dec. 23, 1959 [6]p. incl. diagrs. (AFOSR-TN-60-108) (AF 18(600)1598) AD 231829; PB 145666
Unclassified

Also published in Trans. Metall. Soc. AIME, v. 218: 765-766, Aug. 1960.

Creep tests on bicrystals of pure zinc showed that in zinc there is no explicit relation between the amount of grain boundary sliding and grain boundary migration. Observations made while the specimens were being tested indicate that part of the inactive periods of grain boundary sliding are due to grain boundary migration.

1897

Northwestern U. [Dept. of Metallurgy and Materials Science] Evanston, Ill.

DISLOCATION THEORY OF STRAIN AGING, by T. Mura, E. [A.] Lautenschlager, and J. O. Brittain. Feb. 1, 1960 [18]p. incl. diagrs. table. (AFOSR-TN-60-206) (AF 18(600)1598) AD 233155; PB 145857
Unclassified

The return of the yield point following strain aging results from locking of dislocations by a solute atmosphere and is proportional to the number of solute atoms in the atmosphere along the dislocation. The fraction of the increase in yield point after aging was obtained theoretically by taking account of the dislocation attraction force and the diffusion due to the concentration gradient of solute atoms around the dislocations. The theory was compared with a series of the experiments which were done under several aging temperatures, plastic strains, and aging stresses and was found to give a better agreement with the experimental observation than Harper's relation (Phys. Rev., v. 83: 709, 1951). (Contractor's abstract)

1898

Northwestern U. Dept. of Metallurgy and Materials Science, Evanston, Ill.

ON THE INTERNAL FRICTION OF COLD WORKED AND QUENCHED MARTENSITIC IRON AND STEEL, by T. Mura, I. Tamura, and J. O. Brittain. Sept. 6, 1960 [17]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1121) (AF 18(600)1598) AD 245089; PB 152691
Unclassified

Also published in Jour. Appl. Phys., v. 32: 92-96, Jan. 1961.

A theoretical explanation is given for the internal friction peaks which are observed at 200° C ~ 250° C for cold worked iron and steels and for steels in the martensitic condition. The theory for the peaks is based upon the addition of a term to the free energy in order to account for the strain energy due to the interaction of an atmosphere and the line imperfections. The linear standard solid was obtained from the model in which dislocations are vibrating with an atmosphere of carbide precipitates.

1899

Northwestern U. [Dept. of Metallurgy and Materials Science] Evanston, Ill.

GRAIN BOUNDARY COHESION AND SOLUTE-DISLOCATION INTERACTIONS DURING STRAIN AGING, by J. O. Brittain. Final rept. Nov. 1, 1955-Oct. 31, 1960, 18p. incl. diagrs. refs. (AFOSR-271) (AF 18-(600)1598) AD 251907
Unclassified

The report is concerned with an investigation on grain boundary cohesion and solute-dislocation interactions in metals. It was demonstrated experimentally that the magnitude of the relative displacement of 2 crystals is dependent upon the matrix slip and, in particular, the movement of dislocations into the grain boundary. Obstacles that impede the movement of dislocations into the grain boundary cause a decrease in the magnitude of the grain boundary shear. A low temperature yield criteria that considers the solute density along the dislocation, the line tension of the dislocation, the density of dislocations, the interaction energy between a solute and a dislocation, and the radius of the atmosphere were developed. The theory was found to give excellent agreement with the experimental observations on low temperature yielding. A time law for the segregation of solute atoms to a dislocation also was developed. A theory was developed for the 250° C internal friction peaks observed in cold worked and martensitic steels. (Contractor's abstract)

1900

Northwestern U. Dept. of Metallurgy and Materials Science, Evanston, Ill.

SUBLIMATION OF SMALL SODIUM CHLORIDE SPHERES INTO ARGON, by D. H. Whitmore and J. B. Moser. Apr. 15, 1960 [19]p. incl. diagrs. table, refs. (AFOSR-TN-60-526) (AF 49(638)436) AD 237906; PB 148210
Unclassified

Also published in Jour. Chem. Phys., v. 33: 917-920, Sept. 1960.

The rate of vaporization of sodium chloride into an argon atmosphere was investigated over the temperature range 726° to 770° C using a hot-stage method to follow the change of radius of a small, subliming sodium chloride sphere. An integrated rate expression was derived for the present experimental conditions which showed the square of the radius of the volatile particle to be directly proportional to the time, the proportionality constant being both pressure and temperature dependent. In general, the pressure and temperature behavior of the empirical rate data is consistent with the proposed model which assumes that the vaporization rate is controlled by molecular diffusion of sodium chloride vapor away from the outer edge of a thin boundary layer adjacent to the surface of the sphere undergoing sublimation. (Contractor's abstract)

1901

Northwestern U. Dept. of Metallurgy and Materials Science, Evanston, Ill.

TEMPERATURE AND COMPOSITION DEPENDENCE OF THE STRENGTH OF Al BASE Zn ALLOY SINGLE CRYSTALS, by J. Dash and M. E. Fine. May 1960 [15]p. incl. diagrs. refs. (AFOSR-TN-60-524) (AF 49(638)524) AD 239912 Unclassified

Also published in Acta Metall., v. 9: 149-154, Feb. 1961.

The critical resolved shear stress, σ_c, of zone-hardened Al base Zn alloys was found to increase with $(c_{Zn})^{1/2}$ at room temperature, suggesting that the stress necessary to shear the zones is larger than that necessary to overcome the Mott-Nabarro misfit stresses. On cooling to 4.2°K, σ_c of a particular alloy (e.g. 5.3 at.-% Zn) increases considerably more than predicted. This is attributed in part to off-center cutting of zones and in part to cutting of mismatch dislocations presumed to be located in the region between the core of the zone and the depleted shell. σ_c of zone-hardened Al-6 at.-% Ag was also measured to 4.2°K. The increase in σ_c is considerably less in this case, presumably because the atomic sizes of Al and Ag are nearly the same; misfit dislocations are not expected in this case. The supersaturated solid solution (reverted) state of the Al-Zn alloys was also studied. The percentage increase in σ_c on cooling is considerably greater than in the zone-hardened alloys. This is attributed to the presence of clusters in the solid solution. (Contractor's abstract)

1902

Northwestern U. Dept. of [Metallurgy] and Materials Science, Evanston, Ill.

TRANSFORMATION STUDIES OF GRAY TI SINGLE CRYSTALS, by R. G. Wolfson, M. E. Fine, and A. W. Ewald. June 1960 [14]p. incl. diagrs. (AFOSR-TN-60-794) (AF 49(638)524) AD 241290; PB 150105 Unclassified

Also published in Jour. Appl. Phys., v. 31: 1973-1977, Nov. 1960.

Measurements of the linear growth rate of white tin into thin single-crystal wafers of gray tin, over the temperature range 24.2° - 46.5°C, are presented. The rate is not a single-valued function of the temperature. Imposed upon the strong temperature dependence of the average rate is a variation which is well defined at a given temperature; the spread in the observed values decreases sharply with increasing temperature. The variation is attributed to 2 observed stress-relaxation processes: cleavage in the gray tin and plastic deformation accompanied by recrystallization in the white tin. (Contractor's abstract)

1903

Northwestern U. [Dept. of Metallurgy and Materials Science] Evanston, Ill.

GUINIER-PRESTON ZONES IN AN ALUMINIUM-SILVER ALLOY, by E. J. Freise, A. Kelly, and P. B. Nicholson. [1960] [6]p. incl. illus. diagrs. (AFOSR-962) [AF 49(638)524] Unclassified

Published in Acta Metall., v. 9: 250-255, Mar. 1961.

X-ray small angle scattering measurements and electron microscope transmission studies have been carried out on the same specimen of an Al-Ag alloy containing 4.4 at.-% Ag, quenched and aged at 125°C. The 2 methods are examined and compared. The x-ray method yields values of the average cluster size in excess of those found in the electron microscope examination by a factor of about 2. There are 2×10^{17} clusters/cu cm, with diam varying between 20A and 60A. The average composition of these clusters is greater than 90% Ag and they are surrounded by a shell containing very little Ag. Only about 10% of the alloy undergoes this segregation. (Contractor's abstract)

1904

Northwestern U. Dept. of [Metallurgy] and Materials Science, Evanston, Ill.

THE EFFECT OF ELECTROPOLISHING ON THE RETENTION OF VACANCIES DURING QUENCHING IN Al AND Al ALLOYS, by E. J. Freise, M. E. Fine, and A. Kelly. [1959] [3]p. incl. diagr. (AFOSR-3992) (AF 49(638)524) Unclassified

Also published in Philos. Mag., v. 5: 101-103, Jan. 1960.

Small angle scattering studies of foils 25 to 50 μ thick of Al and an Al-6 at-% Ag alloy quenched from 540°C are reported. These conditions of temperature indicate that a surface film is effective in increasing the magnitude of the double Bragg scattering; escape of vacancies to the surface is reduced. It is noted that the small angle scattering below 1° is considerably larger for the unetched samples. In thin foils the surface is a very important sink for quenched-in vacancies. During the electropolishing a surface film is presumed to form on the specimen, reducing escape of vacancies. The additional quenched-in vacancies then result in an additional number of dislocation loops or spirals. Etching removes the film and the effect is not observed.

1905

Northwestern U. Dept. of Metallurgy and Materials Science, Evanston, Ill.

SEGREGATION OF SOLUTE ATOMS DURING STRAIN AGING, by T. Mura, E. A. Lautenschlager, and J. O. Brittain. [1960] [6]p. incl. table, diagrs. (AFOSR-3592) [AF 49(638)780] Unclassified

Published in Acta Metall., v. 9: 453-458, May 1961.

A theory and verifying experimental data are presented to explain strain aging of iron and steel under several aging strains, stresses and temperatures. The theory developes a relation between the number of solute atoms migrating to a dislocation and the aging time which eventually leads to saturation. A term to account for the bulk diffusion which is due to the carbon concentration gradient developed in the vicinity of the dislocation is also included. The experimental results show the relation between the increase of the yield point after aging and the aging time. Both the theory and the experimental results differ from Harper's, Bullough and Newman's and Ham's formulas. (Contractor's abstract)

1906

Northwestern U. [Dept. of Political Science] Evanston, Ill.

DETERRENCE STRATEGIES: AN ANNOTATED BIBLIOGRAPHY, by R. A. Brody. Apr. 1960, 33p. incl. table, refs. (AFOSR-TN-60-715) (AF 49(638)742) AD 243493 Unclassified

Also published in Conflict Resolution, v. 4: 443-457, Dec. 1960.

An annotated bibliography is presented on deterrence strategies. Deterrence, as it has gained general usage, has come to mean any of a series of proposed strategies which would forstall, i.e., deter possible aggression by making it costly. Thirty-eight items are presented, selected because they represent a broad section of the literature or for the uniqueness of their approach. The major differences between these strategies are found in their answers to 3 questions: (1) What levels of attack should or can be deterred by what levels of response? (2) Assuming a level of response, what pattern of response should be employed? (3) What role should defense play in a deterrence strategy?

1907

Norway Technical U. Inst. for Theoretical Chemistry, Trondheim.

AN ATTEMPT TO DETERMINE THE STRUCTURE PARAMETERS OF CONDENSED RING HYDROCARBONS USING THE ELECTRON-DIFFRACTION METHOD IN GAS MOLECULES, by A. Almenningen, O. Bastiansen, and F. Dyvik. Nov. 23, 1960 [23]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1260) (AF 61-(052)72) AD 252439 Unclassified

Also published in Acta Cryst., v. 14: 1056-1065, Oct. 1961.

Electron diffraction studies were carried out to determine the molecular structure of naphthalene, anthracene, and coronene, using least-squares refinement. For naphthalene a set of structure parameters are obtained of approximately the same accuracy as those from the x-ray crystallographic studies. For anthracene the present study leads to ambiguity, and no single set of parameters can be presented. For coronene the investigation leads to a unique set of values for the C-C bond distances, but the standard deviations are so large that at least two of the distance values must be considered as rather uncertain. (Contractor's abstract)

1908

Norway Technical U. Inst. for Theoretical Chemistry, Trondheim.

MEAN AMPLITUDES OF VIBRATION OF CYCLOPROPANE FROM ELECTRON DIFFRACTION AND SPECTROSCOPIC CALCULATIONS, by A. Almenningen, O. Bastiansen and others. [1960] [2]p. incl. table. (AFOSR-3923) [AF 61(052)72] Unclassified

Also published in Acta Chem. Scand., v. 14: 959-960, 1960.

A rigorous calculation is carried out in order to obtain the values of the mean amplitudes of vibration (u) for the bond distances of cyclopropane. The values were obtained from electron diffraction studies of the molecule in the gaseous state and from theoretical computations based upon spectroscopic data. The results of the study for each atom pair, including spectroscopic measurements at zero degrees and 298°K, and electron diffraction studies are respectively as follows: C-H = 0.0750, 0.0750, and 0.0753 ± 0.0030A; C...H = 0.1082, 0.1090, and 0.108 ± 0.0030A; C-C = 0.0510, 0.514, and 0.497 ± 0.0015A; $H_1 \ldots H_1'$ = 0.1180 and 0.1181A (Spectroscopic studies only); $H_1 \ldots H_2$ = 0.1758 and 0.1783A; $H_1 \ldots H_2'$ = 0.1316 and 0.1320A.

1909

Norway Technical U. [Inst. for Theoretical Chemistry] Trondheim.

ELECTRON SCATTERING FROM IODINE VAPOR, by A. Almenningen, O. Gastiansen and others. [1959] [1]p. (AFOSR-3924) [AF 61(052)72] Unclassified

Also published in Jour. Chem. Phys., v. 32: 616-617, Feb. 1960.

An anomalous effect observed by Karle (Jour. Chem. Phys., v. 23: 1739, 1955) when 40-kv electrons are scattered from iodine vapor was reexamined by taking two sets of electron diffraction sector diagrams, using 38.70 kv and 40.884 kv as accelerating potentials. No phase shift of the order of magnitude reported by Karle was observed. For a more complete analysis of the problem, least-squares calculations were carried out on each of the four single intensity curves of the 40.884 kv plates. The phase shift observed turned out to be 1/5 of that reported by Karle. The r value calculated by these investigators was repeatedly of the order of 2.6A and k was approximately $0.0018A^2$.

1910

Ohio State U. Research Foundation, Columbus.

HIGH FREQUENCY OSCILLATION PHENOMENA, by E. M. Boone, R. M. Campbell and others. Final rept. Dec. 1960, 18p. incl. diagrs. (AFOSR-72) (AF 49-(638)707) AD 249934; PB 154265 Unclassified

A radial-beam retarding-field oscillator in which the cathode surrounds the r-f structure has been designed and constructed as a first prototype of an oscillator that might be scaled for operation at millimeter wavelengths without excessive cathode loading. The propagation characteristics of a dense electron plasma at microwave frequencies are also discussed. A magnetron without a resonant circuit can be utilized as a phase shifter in a waveguide circuit. The results indicate the possibility of developing a phase shifter if a longer interaction region can be utilized.

1911

Ohio State U. Research Foundation. Dept. of Chemistry, Columbus.

STUDY OF SOLID VAPOR EQUILIBRIA IN THE RARE EARTH - RARE EARTH METAL SYSTEMS, by D. White. Final rept. Oct. 1960, 11p. incl. table, refs. (Rept. no. 653) (AFOSR-TR-60-177) (AF 18(600)1545) AD 249224 Unclassified

A list of the various rare-earth oxide systems investigated is given. The phase equilibria, the composition of the solid and vapor phases, at elevated temperatures, are given. A table demonstrates the complexity of the phase equilibria, which were defined, for the first time in the program. Such an extensive investigation was necessary before any thermodynamic analysis of these systems could be made. The rates of vaporization for the 17 systems were measured by the Knudsen effusion technique. These results combined with the phase equilibria data provide the basis for the thermodynamic analysis of the various rare earth-oxygen systems at elevated temperatures.

1912

Ohio State U. [Research Foundation]. Dept. of Chemistry, Columbus.

ON THE USE OF TANTALUM KNUDSEN CELLS IN HIGH TEMPERATURE THERMODYNAMIC STUDIES OF OXIDES, by H. W. Goldstein, P. N. Walsh, and D. White. [1960] [1]p. incl. diagr. refs. [AF 18(600)-1545] Unclassified

Published in Jour. Phys. Chem., v. 64: 1087, Aug. 1960.

Measurements of the volatility of oxides contained in Ta cells can lead to erroneous results because of the formation of gaseous TaO and TaO_2. It is not possible to make corrections for these constituents, because the Ta oxides may be formed by diffusion of an O species through the cell, with resulting formation and volatilization of Ta oxides on the exterior of the Knudsen cell.

1913

Ohio State U. [Research Foundation. Dept. of Chemistry] Columbus.

THE SYNTHESIS AND SOME REACTIONS OF DI-T-BUTYLACETIC ACID AND DI-T-BUTYLKETENE, by M. S. Newman, A. Arkell, and T. Fukunaga. [1959] [4]p. incl. refs. (AFOSR-45) (AF 33(616)3412) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 2498-2501, May 20, 1960.

Di-t-butylacetic acid is prepared in good over-all yield from hexamethylacetone. On treatment of the acid chloride with sodium amide in liquid ammonia di-t-butylketene is formed. This ketene is stable and relatively unreactive compared to other known aliphatic ketenes. The possible intervention of di-t-butylketene in reactions of di-t-butylacetyl chloride raises the general question as to the importance of ketenes in reactions of acid chlorides having a hydrogen on the α-carbon. (Contractor's abstract)

1914

Ohio State U. [Research Foundation. Dept. of Chemistry] Columbus.

THE REDUCTION OF AMIDES TO AMINES VIA NITRILES BY LITHIUM ALUMINUM HYDRIDE, by M. S. Newman and T. Fukunaga. [1959] [4]p. incl. table, refs. (AFOSR-191) (AF 33(616)3412) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 693-696, Feb. 5, 1960.

The isolation of nitriles in lithium aluminum hydride reductions of amides indicates that part, if not all of the reduction involves dehydration of amide to nitrile followed by reduction of nitrile to amine. Such a series of reactions would be: $RCONH_2 + \frac{1}{2}M_4H_4 \rightarrow RCN + M_2O + 2H_2$; $RCN + \frac{1}{2}M_4H_4 \rightarrow RCH_2NM_2$; $RCH_2NM_2 + H_2O \rightarrow RCH_2NH_2 + M_2O$, (M = Li Al/4). The evidence cited to support this scheme is that two equivalents of hydrogen were evolved, good yields of nitriles were obtained during attempts at alkaline hydrolysis at 190-200°C of highly hindered aromatic amides, a small amount of nitrile was formed on attempting to react a hindered acid chloride with sodium amide in liquid ammonia, methyldipropylacetonitrile was obtained from reaction of sodium amide with methyldipropylacetophenone in boiling benzene, and benzonitrile was isolated in small amounts on treatment of thiobenzamide with lithium aluminum hydride.

1915

Ohio State U. [Research Foundation. Dept. of Chemistry] Columbus.

ALKYLATION OF NITRILES: KETENIMINE FORMATION, by M. S. Newman, T. Fukunaga and T. Miva. [1960] [3]p. incl. tables, refs. (AFOSR-192) (AF 33-(616)3412) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 873-875, Feb. 20, 1960.

The alkylation of alkylacetonitriles to trialkylacetonitriles by reaction with alkali amides followed by treatment with alkylating agents is described. In the case of diisopropylacetonitrile, alkylation with isopropyl iodide yields moderate amounts of ketenimine as indicated by isolation after hydration as N-isopropyldiisopropylacetamide. In the case of t-butylisopropylacetonitrile, only ketenimine was obtained. (Contractor's abstract)

1916

Ohio State U. Research Foundation. Dept. of Electrical Engineering, Columbus.

THE ANALYSIS AND PRODUCTION OF DENSE ELECTRON BEAMS FOR USE IN MICROWAVE TUBES, by R. M. Campbell. Final rept. Mar. 1960, 93p. incl. diagrs. tables. (AFOSR-TR-60-50) (AF 18(600)980) AD 237071; PB 147771 Unclassified

The object of this research was to find a means of studying and producing dense electron beams. To achieve the desired results, several mathematical methods of analysis were studied and a pinhole-camera gun tester was built. Of the mathematical methods studied, a relaxation method in conjunction with a resistance analog network appeared to be the most useful. A paraboloidal-spheroidal gun, a nonconfocal spheroidal gun, and a modified Heil gun were analyzed mathematically using the relaxation method. This method was also used to study the space-charge-limited potential distribution in spheroidal and paraboloidal diodes. A toroidal gun capable of high perveance but with resulting low convergence was studied using a gun tester. The pinhole-camera gun tester was utilized to study the paraboloidal-spheroidal gun, the nonconfocal spheroidal gun, the modified Heil gun, and a spherical cathode gun. Current density distributions in the beams, and in some instances transverse velocity distributions, were measured. In all cases, the measurements were made for a range of cold cathode-to-anode spacings. These data are presented in detail and are intended as a guide in the design and utilization of these and similar electron guns. (Contractor's abstract)

1917

Ohio State U. Research Foundation. Dept. of Electrical Engineering, Columbus.

MICROWAVE TUBE RESEARCH ON BARKHAUSEN-KURZ CAVITY-TYPE OSCILLATORS AND A TRANSVERSE-FIELD TRAVELING-WAVE TUBE, by D. T. Davis, F.-S. Chen, and E. M. Boone. Final rept. Dec. 1959, 53p. incl. diagrs. refs. (AFOSR-TN-60-134) (AF 18(600)992) AD 232736; PB 149261 Unclassified

An electron tube employing a magnetically focused electron stream moving in an electric field resulting from a parabolic potential distribution can be operated as a Barkhausen-Kurz oscillator. Oscillators of this type have been investigated at wavelengths of 3 cm, 1 cm, and 6 mm. Two types of geometries have been utilized, one having symmetry about the plane of a flat electron beam, and the other being symmetrical about the axis of a cylindrical electron beam. These tubes have exhibited low starting currents, wide electronic tuning ranges, and efficiencies of 12 to 14% in the 3 cm and 1 cm wavelength range. The transverse-field traveling-wave tube has been investigated in an attempt to produce a wide-range low-noise amplifier in the frequency range from 1 to 2 kmc. A complete theoretical analysis of the device has been conducted, and an experimental tube has been tested. Performance approaching theoretical figures has not been realized. A maximum insertion gain of 6 db at 1.25 kmc has been obtained. (Contractor's abstract)

1918

Ohio State U. Research Foundation. Dept. of Electrical Engineering, Columbus.

FLOATING ZONE REFINING OF BORON USING ELECTRON BEAM MELTING, by M. O. Thurston and C. B. Hood. May 1961, 5p. incl. diagrs. (AFOSR-TN-60-791) (AF 49(638)424) AD 260074 Unclassified

Also published in Jour. Electrochem. Soc., v. 109: 66-68, Jan. 1962.

Boron rods, prepared by the reduction of boron trichloride with hydrogen, were refined by the floating zone process. The melting was accomplished by electron bombardment, using a 3000 v, 0.2 amp beam. The band gap for a zone refined sample after 3 passes was 1.30 ev as determined from resistivity measurements. It was observed that carbon is an electrically active impurity, and that nickel and tungsten are not. (Contractor's abstract)

1919

Ohio State U. Research Foundation. Dept. of Mathematics, Columbus.

ON REGULAR AND SINGULAR HARMONIC FUNCTIONS OF THREE VARIABLES, by E. Kreyszig. May 1960, 27p. incl. diagrs. refs. (Technical note no. 2) (AFOSR-TN-60-456) (AF 49(638)362) AD 236534; PB 147358 Unclassified

Also published in Arch. Rational Mech. and Analysis, v. 4: 352-370, 1960.

The properties of regular and singular solutions of Laplace's equation $\Delta\varphi = \varphi_{xx} + \varphi_{yy} + \varphi_{zz} = 0$ is considered

by means of function theoretical methods. The first part of the paper is devoted to an infinite set of independent regular particular solutions such that any solution of the equation, regular at the origin, can be represented in terms of these particular solutions. Then methods are considered for investigating solutions which have singularities. Classes of solutions are obtained which are singular on a given circle and other classes which are singular on more general algebraic curves in real three-dimensional space. A method is also discussed of obtaining properties of the singularities of harmonic functions in terms of the coefficients of their series developments in terms of spherical harmonics. A representation of certain harmonic functions in terms of hypergeometric functions is given.

1920

Ohio State U. [Research Foundation. Dept. of Physics and Astronomy] Columbus.

PROTON RELAXATION TIMES IN H_2O-SiO_2 AND H_2O-CuO MIXTURES (Abstract), by I. G. Post and L. C. Brown. [1960] [1]p. (AFOSR-TN-60-2) [AF 18(600)772] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 74, Jan. 27, 1960.

Measurements of T_1 and T_2 have been made in water-solid mixtures in which the particle size of the solid was controlled. As expected, the value of T_2 decreases with decreasing particle size in H_2O-CuO more rapidly than in H_2O-SiO_2. The value of T_1 remains nearly constant except for the very small (0.05 mm) particle sizes; however, T_1 for H_2O-CuO is somewhat larger than for H_2O-SiO_2.

1921

Ohio State U. [Research Foundation. Dept. of Physics and Astronomy] Columbus.

NUCLEAR MAGNETIC RESONANCE SPECTRA OF HALOGENATED ETHANES (Abstract), by D. D. Elleman, L. C. Brown, and D. Williams. [1959] [1]p. (AFOSR-TN-60-3) [AF 18(600)772] Unclassified

Presented at meeting of the Amer. Phys. Soc., Cleveland, Ohio, Nov. 27-28, 1959.

Published in Bull. Amer. Phys. Soc., Series II, v. 4: 418, Nov. 27, 1959.

The magnetic resonance spectra of H^1 and F^{19} in ethyl fluoride, ethyl chloride, ethyl bromide, and various multiply halogenated ethanes have been investigated at room temperatures. Characteristic chemical shifts have been measured and spin-spin hyperfine structure has been observed. In measuring chemical shifts, a 10% solution of H_2O in D_2O was used as a reference for H^1 resonance, while a pure sample of octofluorocyclobutane was used for F^{19} resonances. It was found that the shielding constant $\delta = [(\nu - \nu_{ref})/\nu_{ref}] \times 10^6$ had values in the range 3.2 to 4.4 for CH_3 protons; 0.8 to 1.1 for CH_2F protons, with slightly larger values for CH_2Cl and CH_2Br protons; and -0.6 to -0.2 for CF_2H protons. For F^{19} resonances, values of δ were larger and ranged from approximately 75 to 110 for CH_2F; -30 to +5 for CHF_2; and -73 to -48 for CF_3 groups. The shielding constant δ had slightly more negative values for F^{19} in CF_2Cl and CF_2Br groups than in CF_3. Values of the spin-spin coupling constants J were determined for various pairs of non-equivalent spin $\frac{1}{2}$ nuclei in each molecule.

1922

Ohio State U. [Research Foundation. Dept. of Physics and Astronomy] Columbus.

NUCLEAR MAGNETIC RESONANCE STUDY OF HINDERED ROTATION IN CF_2H - CF_2-CFH Br (Abstract), by D. D. Elleman and D. Williams. [1960] [1]p. (AFOSR-TN-60-1215) (AF 18(600)772) Unclassified

Presented at meeting of the Amer. Phys. Soc., Ohio State U., Columbus, Oct. 28-29, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 93, Feb. 1, 1961.

At room temperature the F^{19} resonance associated with the CF_2H group in CF_2HCF_2 CFH Br consists of 2 chemically shifted wide doublets instead of the single wide doublet due to a spin-spin interaction with the proton, which might be expected for this group in a molecule in which there is free rotation about C-C bonds. The resonance in question has now been studied over a range of temperatures between -96°C and +100°C. As the temperature increases, there is a marked change in the appearance of the resonance. The observed changes are interpreted in terms of a strongly temperature-dependent relative chemical shift between the F^{19} sites in 2 different configurations of the molecule associated with hindered internal rotation. At +100°C, the relative chemical shift is so small that a single wide doublet is observed. Each component of the wide doublet consists of more closely spaced components attributed to spin-spin interactions of F^{19} in the CF_2H group with spin 1/2 nuclei in other parts of the molecule.

1923

Ohio State U. [Research Foundation]. Dept. of Physics [and Astronomy] Columbus.

THE NUCLEAR MAGNETIC RESONANCE SPECTRA

OF FLUOROCARBONS. PART I. HALOGENATED ETHANES, by D. D. Elleman, L. C. Brown, and D. Williams. [1960] [15]p. incl. diagrs. table. (AFOSR-TN-60-1216) [AF 18(600)772] Unclassified

Also published in Jour. Molec. Spectros., v. 7: 307-321, Nov. 1961.

The nuclear magnetic resonance spectra of the following substituted ethanes have been observed: CH_3CH_2Br, CH_3CH_2Cl, CH_3CH_2F, CHF_2CH_3, CF_3CH_3, CF_2ClCH_3, CF_2BrCH_3, CF_3CF_2H, CF_3CH_2F, CF_3CH_2Cl, CF_3CH_2Br, and CHF_2CHF_2. In nearly every case it has been possible to present a satisfactory interpretation of the observed spectra in terms of a remarkably simple application of theory involving chemical shifts characteristic of each of the groups in each molecule and intra-molecular spin-spin coupling constants involving H^1 and F^{19} nuclei. (Contractor's abstract)

1924

Ohio State U. [Research Foundation]. Dept. of Physics [and Astronomy] Columbus.

THE NUCLEAR MAGNETIC RESONANCE SPECTRA OF FLUOROCARBONS. PART II. HALOGENATED n-PARAFFINS, by D. D. Elleman, L. C. Brown, and D. Williams. [1960] [19]p. incl. diagrs. tables. (AFOSR-TN-60-1217) [AF 18(600)772] Unclassified

Also published in Jour. Molec. Spectros., v. 7: 322-340, Nov. 1961.

The nuclear magnetic resonance spectra of H^1 and F^{19} have been observed in 11 halogenated propanes, 2 fluorinated butanes, 1 fluorinated pentane, 4 fluorinated hexanes, and 1 fluorinated octane. Characteristic chemical shifts and spin-spin coupling constants are listed for each molecule. As the length of the carbon chain becomes longer in the normal paraffins, it becomes increasingly difficult to interpret the observed spectra, since the resolved lines become broader as a result of viscosity effects and of the increased number of unresolved hyperfine components produced by spin-spin coupling. (Contractor's abstract)

1925

Ohio State U. [Research Foundation]. Dept. of Physics [and Astronomy] Columbus.

THE NUCLEAR MAGNETIC RESONANCE SPECTRA OF FLUOROCARBONS. PART III. HALOGENATED PROPYNES, PROPENES, BUTENES, AND CYCLOPENTENES, by H. M. Beisner, L. C. Brown, and D. Williams. [1960] [8]p. incl. diagrs. table. (AFOSR-TN-60-1218) [AF 18(600)772] Unclassified

Also published in Jour. Molec. Spectros., v. 7: 385-392, Dec. 1961.

For abstract see following item no. 1926.

1926

Ohio State U. [Research Foundation. Dept. of Physics and Astronomy] Columbus.

NUCLEAR MAGNETIC RESONANCE SPECTRA OF SEVERAL FLUORINATED UNSATURATED AND SATURATED HYDROCARBONS (Abstract), by H. M. Beisner. [1960] [1]p. (AFOSR-TN-60-1219) (AF 18-(600)772) Unclassified

Presented at meeting of the Amer. Phys. Soc., Ohio State U., Columbus, Oct. 28-29, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 93, Feb. 1, 1961.

The nuclear magnetic resonance spectra of 1 fluorinated propyne ($CF_3C{:}CH$)[1], 4 halogenated propenes and butenes (CCl_2CHCF_3, $CClFCHCF_3$, $CF_3CClCClCF_3$ and $CF_3CClCFCF_3$), and 2 halogenated cyclopentenes (1, 2-dichlorohexafluorocyclopentene and perfluorocyclopentene) have been investigated. In general, chemical shifts could be determined for H^1 and F^{19} at various intramolecular sites; in most cases, spin-spin coupling constants could be determined. The molecular parameters obtained from analyses of the observed spectra are tabulated.

1927

Ohio State U. [Research Foundation]. Dept. of Physics [and Astronomy] Columbus.

THE NUCLEAR MAGNETIC RESONANCE SPECTRA OF FLUOROCARBONS. PART IV. DISCUSSION OF CHEMICAL SHIFTS AND SPIN COUPLING CONSTANTS, by D. D. Elleman, L. C. Brown, and D. Williams. [1960] [6]p. incl. diagrs. (AFOSR-2462) [AF 18(600)772] Unclassified

Also published in Jour. Molec. Spectros., v. 7: 393-398, Dec. 1961.

The chemical shifts and spin-spin coupling constants obtained in studies of 12 halogenated ethanes, 11 halogenated propanes, and 8 fluorinated higher normal paraffins including butanes, pentanes, hexanes, and octanes are summarized. A graphical summary of the data on total chemical shifts reveals certain systematic relations. Certain general characteristic values of spin-spin coupling constants are noted and attention is drawn to certain possibly unexpected variations of coupling constants with variation in molecular environment. (Contractor's abstract)

1928

Ohio State U. [Research Foundation. Dept. of Physics and Astronomy] Columbus.

NUCLEAR MAGNETIC RESONANCE SPECTRA OF HALOGENATED PROPANE (Abstract), by D. D. Elleman, L. C. Brown, and D. Williams. [1960] [1]p. [AF 18(600)772] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 74, Jan. 27, 1960.

The magnetic resonance spectra of H^1 and F^{19} in various halogenated propanes have been investigated at room temperature. The experimental techniques employed were similar to those used in an earlier study of substituted ethanes. Characteristic chemical shifts were determined for H^1 and F^{19} in various nonequivalent groups. Values for the observed shifts will be given and compared with those obtained in the ethane study. Values of the spin-spin coupling constants J were determined for various pairs of non-equivalent spin 1/2 nuclei in each molecule. There is a general correlation between the magnitude of J and the proximity of the interacting nuclei, however, certain marked exceptions of this general correlation have been noted.

1929

Ohio State U. [Research Foundation. Dept. of Physics and Astronomy] Columbus.

ELECTRON SPIN RESONANCE IN SOME BIVALENT SILVER AND COPPER SALTS (Abstract), by B. Y. Cho and L. C. Brown. [1960] [1]p. [AF 18(600)772] Unclassified

Presented at meeting of the Amer. Phys. Soc., Ohio State U., Columbus, Oct. 28-29, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 92, Feb. 1, 1961.

The electron spin resonance spectra of Ag^{++} and Cu^{++} in silver picolinate, copper picolinate, and tetrapyridine copper persulfate have been investigated at room temperature and at liquid nitrogen temperature. The picolinate spectra (from powdered crystals) yield the following values for g: for Ag^{++}, $g_{\perp} = 2.039 \pm 0.002$, $g_{\parallel} = 2.180 \pm 0.002$; for Cu^{++}, $g_{\perp} = 2.053 \pm 0.002$, $g_{\parallel} = 2.235 \pm 0.002$. The persulfate spectrum is more symmetrical possibly indicating that the variation in g are small in comparison with the line widths ($g = 2.082 \pm 0.002$). No remarkable differences were noticed in the spectra at liquid nitrogen temperature.

1930

Ohio State U. [Research Foundation]. Dept. of Physics [and Astronomy] Columbus.

PERTURBATION THEORY OF ANTIFERROMAGNETISM, by R. L. Mills, R. P. Kenan, and J. Korringa. [1960] [11]p. (AFOSR-TN-60-628) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)264] and National Science Foundation) Unclassified

Presented at Internat'l. Cong. on Many-Particle Problems, Utrecht (Netherlands), June 13-18, 1960.

Also published in Physica, Suppl., v. 26: S204-S214, Dec. 1960.

An expansion in terms of connected diagrams is derived for the partition function of an antiferromagnetic spin system with isotropic exchange Hamiltonian. It is shown that the series can be obtained as a perturbation over the Néel theory. A high-temperature perturbation expansion is suggested, which is of similar structure, but with the internal field being replaced by a purely imaginary quantity. The importance of summation is stressed in connection with the fact that the entire formalism is in configuration space. A method is indicated in which the thermodynamic energy plays a central role. (Contractor's abstract)

1931

Ohio State U. Research Foundation. Dept. of Physics and Astronomy, Columbus.

NEW METHOD FOR TREATING THE ANTIFERROMAGNETIC GROUND STATE, by H. L. Davis. [1960] [13]p. incl. diagrs. tables, refs. [Technical note no. 2] (AFOSR-727) (AF 49(638)264) AD 257042 Unclassified

Published in Phys. Rev., v. 120: 789-801, Nov. 1, 1960.

A perturbation expansion for the ground-state energy of an antiferromagnetic spin system is obtained in terms of a linked-spin-cluster expansion similar to Goldstone's linked-Feynman-diagram expansion for the interacting Fermion system. From the energy perturbation series, perturbation series for the long- and short-range order may be obtained. Using these perturbation series, the ground-state properties are calculated through seventh order and compared with the results obtained by other investigators. In all cases, the values obtained here for the ground-state energy are lower than those which have been obtained by purely variational means. The results for the long-range order are radically different from the variational results but agree qualitatively with those obtained by spin-wave theory; however, the method is free of the usual objections which are voiced to spin-wave treatments of antiferromagnetism. The present work is incomplete in that limits on the error introduced by using only a finite number of terms of the perturbation series to calculate the physical properties are not obtained. (Contractor's abstract)

1932

Ohio State U. Research Foundation. Dept. of Physics and Astronomy, Columbus.

ELECTRON ENERGY BANDS OF ONE-DIMENSIONAL RANDOM ALLOYS, by J. S. Faulkner and J. Korringa. [1960] [7]p. incl. diagrs. refs. (AFOSR-957) (AF 49-(638)264) AD 259777 Unclassified

Also published in Phys. Rev., v. 122: 390-396, Apr. 15, 1961.

A method for calculating the density of states for an infinite 1-dimensional random alloy is obtained by

investigating the asymptotic behavior of the trace of the "transmission" matrix which relates the values taken on by the wave function and its derivative at either end of the crystal. This matrix can be calculated if the potentials of the constituent A and B atoms, V_A and V_B, are given. The equations are first derived for a very general case, and then the results of a calculation for an alloy in which the A and B atoms have equal concentrations is shown for the case that V_A and V_B are δ-function potentials. Certain generalizations of the method for treating other nonperiodic problems are discussed briefly. (Contractor's abstract)

1933

Ohio State U. Research Foundation. Dept. of Psychology, Columbus.

THE BEHAVIOR OF PRISONERS IN A "PRISONER'S DILEMMA" GAME, by A. Scodel and S. Minas. Oct. 1960 [6]p. (Technical note no. 1) (AFOSR-TN-60-1052) (AF 49(638)317) AD 245695 Unclassified

Also published in Jour. Psychol., v. 50: 133-138, 1960.

A two-person non-zero-sum game known as a prisoners dilemma is used to test eighteen pairs of subjects obtained from the population of the Federal Reformatory at Chillicothe, Ohio. The behavior of the participants is tested for collaborative vs competitive playing. Cigarettes are used as payoffs, five cigarettes if one pushes the red button and none for the other subject choosing black, three cigarettes for each if both choose black, and one cigarette for each subject if both choose red. Fifteen pairs displayed a competitive strategy while none showed collaboration. The over-all results, which are almost identical with those of a college population, point to an unwillingness to engage in collaborative behavior in two very dissimilar populations.

1934

Ohio State U. Research Foundation. Dept. of Psychology, Columbus.

SOME DESCRIPTIVE ASPECTS OF TWO-PERSON NON-ZERO-SUM GAMES. II, by J. S. Minas, A. Scodel and others. Oct. 1960 [11]p. incl. tables. (Technical note no. 2) (AFOSR-TN-60-1053) (AF 49-(638)317) AD 232544 Unclassified

Also published in Conflict Resolution, v. 4: 193-197, June 1960.

The behavior of pairs of subjects in non-zero sum game situation is analyzed. The payoff matrices of several such G-type games are studied so as to explain the development of competitive or collaborative strategy in the groups used in the experiment. It is postulated that the money has slightly more utility in the early part of the game than the psychological need to outdo the other person, but the reverse holds for the latter part of the game. The conclusion is that a maximization-of-difference principle is most frequently operative and necessitates a competitive strategy.

1935

Ohio State U. [Research Foundation. Dept. of Psychology] Columbus.

ORGANIZATION, MANAGEMENT STRATEGY, AND TEAM PRODUCTIVITY, by H. B. Pepinsky and P. N. Pepinsky. [1959] 37p. incl. refs. (AFOSR-TN-60-38) (AF 49(638)373) Unclassified

A series of experiments on motivation and productivity are summarized. Emphasis is given to 4 experiments, in particular, performed under the sponsorship of ONR's Group Psychology Branch. Both the background and a set of definitions and assumptions basic to the experiments are briefly described. Each experiment could be conceived as a social system, in which teams of students shared with a research group responsibility for the performance of system tasks. The research group's management strategies were inferred to be effective when accompanied by the repeated occurrence of anticipated higher or lower productivity scores. The management strategies were experiments of (1) task relevant personal belief, (2) task complexity and time pressure, (3) group orientation and related type of task, and (4) confirmation vs contradiction of management policy commitments.

1936

Ohio State U. [Research Foundation. Dept. of Psychology] Columbus.

COUNSELING AS A PROCESS OF NEGOTIATION, by H. B. Pepinsky. [1959] 8p. (AFOSR-TN-60-121) (AF 49(638)373) AD 430659 Unclassified

Presented at Symposium on Counseling, Learning and Theory, Cincinnati, Ohio, Sept. 7, 1959.

Negotiation is a process through which two or more persons come to understand how to act in a given situation. Counseling is described here as simply a particular instance of the general process of negotiation in everyday life. This approach affords opportunity not only to analyze counseling events in new and meaningful ways, but to compare such events with other instances of negotiation. This, the author does from several perspectives: political, structural, cultural, technical, phenomenal, and dramaturgical. This heuristic approach is expected to yield increased knowledge for the counseling psychologist.

1937

Ohio State U. [Research Foundation. Dept. of Psychology] Columbus.

ORGANIZATIONAL BEHAVIOR: STUDIES OF VALUE-DIMENSIONS, by C. L. Shartle. [1960] 11p. (AFOSR-TN-60-881) (AF 49(638)447) Unclassified

Presented at Sixteenth Internat'l. Cong. on Psychology, Bonn (Germany), July 31-Aug. 6, 1960.

This research considers the preparation and testing of

taxonomy of organizations and the development of a predictive model in which value dimensions and situational variables are important aspects. Descriptive written statements of behavior occurring in organizations are used as obtained from other studies and from having adult respondents prepare statements of "good" behaviors, "poor" behaviors, and behaviors which would reveal individual differences in value judgments. The items are selected to include various organizational characteristics including purpose history, structure, magnitude, policies, internal activities, environmental interactions and physical resources.

1938

Oklahoma State U., Stillwater.

LUMINESCENCE IN SEMICONDUCTING DIAMOND (Abstract), by J. B. Krumme and W. J. Leivo. [1960] [1]p. [AF 18(603)40] Unclassified

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 187, Mar. 21, 1960.

Various forms of luminescence in semiconducting diamond were investigated in order to correlate the results with other known properties of the same specimens. Ultraviolet light induced blue luminescence was observed in the investigated temperature range of 90°K to 430°K, and the spectrum extended from 375 mμ to 615 mμ with a maximum at 500 mμ at 90°K and 480 mμ at 300°K. The temperature dependence of the luminescent intensity indicated that the luminescence is a slow fluorescence rather than a phosphorescence. One specimen has a blue region and a clear region, and in the former the luminescence is considerably more intense, the electrical conductivity much higher and the photoconductive response different from that in the clear region. Both regions are p-type semiconductors. Electroluminescence and triboluminescence were observed in all specimens. An unusual red luminescence with a longer lifetime than the blue luminescence was found in 2 of the samples. The red luminescent intensity which is quite low at room temperature increases with increasing temperature being already quite apparent at 330°K, thus implying a phosphorescent process.

1939

Oklahoma State U. Dept. of Chemistry, Stillwater.

AUTOMATIC POLAROGRAPH FOR USE WITH SOLUTIONS OF HIGH RESISTANCE, by P. Arthur, P. A. Lewis and others. [1960] [4]p. incl. diagrs. (AF 18-(600)477) Unclassified

Published in Anal. Chem., v. 33: 488-491, Apr. 1961.

A new polarograph and cell for use with solutions of high electrical resistance are described. The apparatus employs a strip-chart function plotter, the pen of which moves as a function of one potential while the chart follows another. By using the pen to trace current while the chart measures the changing potential of the microelectrode with respect to a reversible electrode through which no current is drawn, polarographic curves of current vs effective voltage are obtained, thus eliminating iR drop. Aqueous cells with resistances as great as 500,000 ohms have been successfully employed, and organic solvents (e.g., 1-octanol) with cell resistances up to 6 megohms have given satisfactory polarograms with this apparatus. (Contractor's abstract)

1940

Oklahoma State U. Dept. of Chemistry, Stillwater.

ACTIVITIES IN AQUEOUS HYDROCHLORIC ACID MIXTURES WITH TRANSITION METAL CHLORIDES. II. MANGANESE(II) CHLORIDE AND COPPER(II) CHLORIDE, by T. E. Moore, F. W. Burtch, and C. E. Miller. [1960] [5]p. incl. diagrs. tables, refs. (AFOSR-TN-60-475) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)478 and Office of Ordnance Research under DA 23-072-ORD-1057) Unclassified

Also published in Jour. Phys. Chem., v. 64: 1454-1458, Oct. 1960.

The activity of each of the components in the systems $MnCl_2$-HCl-H_2O and $CuCl_2$-HCl-H_2O has been determined at 25°C for 3 series of solutions at constant HCl molalities of 4.7, 7.0, and 9.0, respectively. The results are interpreted in terms of hydration and chloro-complexing at high solute activities. Water vapor pressure lowerings are closely additive for the manganese system, and a lower degree of hydration for $MnCl_2$ than $NiCl_2$ in corresponding mixtures with HCl is indicated. (Contractor's abstract)

1941

Oklahoma State U. Dept. of Chemistry, Stillwater.

ISOLATION OF CRYSTALLINE UREASE, by G. Gorin. Feb. 1960 [18]p. incl. illus. table, refs. (Technical note no. 5) (AFOSR-TN-60-238) (AF 18(603)135) AD 236821; PB 147631 Unclassified

Also published in Proc. Oklahoma Acad. of Science, v. 40: 62-70, 1960.

An account is presented of some experiences encountered in the course of preparing crystalline urease. After many unsuccessful and partially successful attempts, several preparations of high activity, 89-106 S. U./mg, were obtained, and it is believed that a detailed description of the successful procedure, and a briefer discussion of related matters, should prove of value to other investigators interested in the preparation of the crystalline enzyme. (Contractor's abstract)

1942

Oklahoma State U. [Dept. of Chemistry] Stillwater.

STUDIES ON UREASE, by G. Gorin, L. G. Butler and others. Final rept. Sept. 1, 1956 - June 30, 1960. Aug. 1960, 7p. (AFOSR-TR-60-115) (AF 18(603)135) AD 243799 Unclassified

The hydrolysis of ammonium carbamate was studied to determine whether this compound was the first product of urease action. The reaction of cystine with sulfide was also investigated. This reaction is of interest in connection with the chemistry of urease since it was anticipated that the enzyme would contain disulfide groups which might be split by sodium sulfide. In collaboration with W. L. Nelson, some preparations of crystalline urease were obtained. With these preparations and with the knowledge of the hydrolytic behavior of ammonium carbamate, it was possible to demonstrate that ammonium carbamate was indeed the primary product in the urease-catalyzed hydrolysis of urea.

1943

Oklahoma U. Dept. of Physics, Norman.

IMPROVED PYREX DEMOUNTABLE PHOTOMULTIPLIER REFRIGERATOR, by R. M. St. John. Mar. 1961 [2]p. incl. diagrs. (AFOSR-TN-60-899) (AF 49-(638)41) AD 261316 Unclassified

Also published in Rev. Scient. Instr., v. 32: 370-371, Mar. 1961.

The advantages of the present design over the previous one (see item no. OKU. 02:001, Vol. II) are: simpler construction, considerably smaller physical size and greater solid angle subtended by the photomultiplier cathode. This refrigerator can accommodate a variety of tubes having the cathodes in the end, and can easily be adapted to larger tubes because of its cylindrical symmetry. It is evacuated when in operation to reduce heat transfer from the outside to the tube and to prevent sparking across tube electrodes.

1944

Oklahoma U. [Dept. of Physics] Norman.

MULTIPLE STATE TRANSFER OF EXCITATION IN HELIUM AND THE WIGNER RULE. I., by R. M. St. John and R. G. Fowler. [1960] [27]p. incl. diagrs. table, refs. (AFOSR-TN-60-900) (AF 49(638)41) AD 261317 Unclassified

Also published in Phys. Rev., v. 122: 1813-1820, June 15, 1961. (Title varies)

A new process of excitation transfer is proposed which minimizes the conflict with the Wigner rule by reducing the sizes of the cross sections required to values close to the gas-kinetic cross section. It is hypothesized that many ^1P states including those with large quantum number n, transfer excitation energy to neighboring triplet states having closely corresponding principle quantum numbers. The triplet states thus formed in turn populate low level triplet states by radiative transitions. It is found that states with n between [4 and 15 handle more than 95%] of the transferred excitation. Satisfying qualitative explanations of several additional excitation transfer process phenomena are derived from this new multiple state transfer process. (Contractor's abstract)

1945

Oklahoma U. Dept. of Physics, Norman.

THEORY OF COLLISION TRANSFER OF EXCITATION IN HELIUM, by C. C. Lin and R. G. Fowler. [1961] [9]p. incl. refs. (AFOSR-TN-60-901) (AF 49(638)41) Unclassified

Also published in Ann. Phys., v. 15: 461-469, Sept. 1961.

A theory is presented to explain a multiple state mechanism for the transfer of excitation from singlet to triplet states in helium atoms (Phys. Rev., v. 122: 1813-1820, 1961). The spin-orbit interaction produce substantial singlet-triplet mixing in the F states which is responsible for the transfer. It is shown that a helium atom in an $n\,^1P$ state, after colliding with a normal atom, transfers primarily into the mixed nF states which in turn cascade to $3\,^3D$. The population of the $3\,^3D$ state is calculated as 4.0×10^5 atoms/cm^3 as compared to 1.28×10^5 atoms/cm^3 from experimental results. (Contractor's abstract)

1946

Oklahoma U. Dept. of Physics, Norman.

THE WIGNER RULE AND MULTIPLE STATE TRANSFER OF EXCITATION IN HELIUM (Abstract), by R. M. St. John and R. G. Fowler. [1960] [1]p. (AFOSR-TN-60-926) (AF 49(638)41) Unclassified

Presented at Thirteenth Gaseous Electronics Conf., Monterey, Calif., Oct. 12-14, 1960.

Also published in Bull. Amer. Phys. Soc., Series II, v. 6: 388, Jan. 22, 1961. (Title varies)

Observations were made on light emission from certain low triplet levels of helium gas traversed by a monoenergetic electric beam. Helium pressure and electron energy were varied. A major part of the triplet excitation was formerly assigned to direct transfer from ^1P states in gross violation of the Wigner Spin Conservation rule. Transfer of excitation by a new process is proposed wherein the conflict with the Wigner rule is minimized by greatly reducing the cross sections required by data to values near the gas-kinetic value. It is assumed that many ^1P states including those with large quantum number n transfer excitation energy to neighboring triplet states having closely corresponding principal qunatum numbers. The triplet

states thus formed in turn populate low level triplet states by radiative transitions. It is found that states lying between n = 6 and n = 20 play the dominant role in the transfer process. The new multiple state transfer process is used in the deviation of qualitative explanations of several additional transfer phenomena.

1947

Oklahoma U. [Dept. of Physics] Norman.

EXCITATION OF HELIUM TRIPLET STATES BY ELECTRON IMPACT (Abstract), by R. M. St. John. [1960] [1]p. [AF 49(638)41] Unclassified

Presented at meeting of the Amer. Phys. Soc., Rice Inst., Houston, Texas, Mar. 4-5, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 103, Mar. 4, 1960.

Measurements have been made on helium concerning excitation from the ground state to triplet states by electron impact. Each triplet excitation function rises steeply from zero at the excitation potential, has a single sharp peak in the energy range between 30 and 35 ev, and at higher energies drops off a little less slowly than the inverse of the electron energy. The helium pressure was maintained at less than 10^{-2} mm in order to make insignificant collisional transfer of energy and other secondary processes. The triplet excitation function exhibits its peak at a much lower energy than the singlet function. The peak of the 3^1P function is rather broad and occurs at 100 ev.

1948

Oregon U. [Dept. of Mathematics] Eugene.

ONE-DIMENSIONAL TOPOLOGICAL SEMILATTICES, by L. W. Anderson and L. E. Ward, Jr. [1959] [5]p. (AFOSR-TN-60-775) [AF 49(638)889] Unclassified

Published in Illinois Jour. Math., v. 5: 182-186, June 1961.

The authors contribute to the general problem of the acyclicity of compact connected semigroups with zero by proving that if 1 such is commutative, idempotent, 1-dimensional and locally connected, then it is a tree (dendrite). Moreover, such semigroups admit an algebraically induced partial order as well as a topologically induced partial order (the cutpoint order), and these are shown to be identical.

1949

Oregon U. [Dept. of Mathematics] Eugene.

ON LOCAL TREES, by L. E. Ward, Jr. [1959] [5]p. incl. refs. (AF 49(638)889) Unclassified

Published in Proc. Amer. Math. Soc., v. 11: 940-944, Dec. 1960.

Three characterizations of local dendrites and trees are given. It is shown that a Peano continuum is a local dendrite (1) if and only if it contains no small simple closed curves, and (2) if it is an absolute neighborhood retract of dimension not exceeding unity. (3) The third characterization is order-theoretic and is an extension of a previous theorem given by the author.

1950

Oregon U. [Dept. of Mathematics] Eugene.

CHARACTERIZATION OF THE FIXED POINT PROPERTY FOR A CLASS OF SET-VALUED MAPPINGS, by L. E. Ward, Jr. [1960] [6]p. (AF 49(638)889) Unclassified

Published in Fundamenta Math., v. 50: 159-164, 1961.

It is proven that if X is an arc-wise connected compact metric space, then X has the fixed point property for the class of upper semi-continuous, continuum-valued mappings if and only if X is hereditarily unicoherent. By combining the results found here with those of Wallace and Plunkett, the following is noted: (1) X is a dendrite; (2) X has the fixed point property for the class of upper semi-continuous continuum-valued mappings; and (3) X has the fixed point property for the class of continuous, closed set-valued functions.

1951

Oslo U. [Inst. of Chemistry] (Norway).

INVESTIGATION OF MOLECULAR STRUCTURES. I. STRUCTURE OF THE SOLID COMPOUND FORMED BY ADDITION OF TWO MOLECULES OF IODINE TO ONE MOLECULE OF PYRIDINE, by O. Hassel and H. Hope. II. THE CRYSTAL STRUCTURE OF THE 1:1 ADDITION COMPOUND FORMED BY BENZYL SULPHIDE AND IODINE, by Chr. Rømming. Oct. 24, 1960 [32]p. incl. diagrs. tables, refs. (Technical scientific note no. 2) (AFOSR-40) (AF 61(052)71) AD 252389 Unclassified

Part I: also published in Acta Chem. Scand., v. 15: 407-416, 1961.

Part II: also published in Acta Chem. Scand., v. 14: 2145-2151, 1960.

Part I. The crystals of the compound pyridine · $2I_2$, are monoclinic, have the space group P_{2_1}/c, and have the lattice constants a = 4.42A; b = 15.37A; c = 17.65A; and β = 103.8A. The unit cell contains four molecules of pyridine and sixteen atoms of iodine. Centrosymmetrical cations - Py_2I^+ - appear to be nearly planar. The remaining iodine atoms form a network built up of centrosymmetrical triiodide ions with an I-I distance of 2.93A and of iodine molecules (I-I = 2.74A). Each of the "outer" atoms of the I_3^- ions is linked to two

iodine atoms belonging to iodine molecules by bonds of length 3.44A. The N-I distance in the cation was measured at 2.16A. The substance investigated may properly be regarded as dipyridineiodine heptaiodide. Part II. The crystals of a compound containing one molecule of benzyl sulfide and one molecule of iodine were found to be orthorhombic with the following dimensions: a = 9.86A; b = 16.86A; and c = 9.36A. The space group is Pnma with four molecules of $(C_6H_5CH_2)_2 S \cdot I_2$ in the unit cell. There is a linear S-I-I arrangement with the observed bond distances 2.78A for S-I and 2.82A for I-I. The investigation shows that organic sulphur compounds may act as electron donors to form molecular addition compounds in the same way as amines. (Contractor's abstract)

1952

Oslo U. Inst. of Chemistry (Norway).

INVESTIGATION OF MOLECULAR STRUCTURES. I. CRYSTAL STRUCTURE OF THE 1:1 ADDITION COMPOUND FORMED BY 4-PICOLINE AND IODINE, by O. Hassel and Chr. Rømming. Dec. 23, 1960 [14]p. incl. diagrs. tables, refs. (Technical scientific note no. 3) (AFOSR-290) (AF 61(052)71) AD 254978
Unclassified

The crystal structure of an equimolecular addition compound of 4-picoline and iodine was determined by x-ray methods at temperatures of about -40°C. The space group is $P2_1/c$, the lattice parameters: a = 4.72A; b = 9.05A; c = 21.55A; $\beta = 101°$. The I-I-N arrangement is linear with the I-I distance 2.83A and the I-N distance 2.31A. (Contractor's abstract)

1953

[Oslo U.] Inst. of Chemistry (Norway).

THE STRUCTURE OF SOME SALTS OF 2:6-DIMETHYL-γ-PYRONE (2:6-DIMETHYL-4H-PYRAN-4-ONE), by H. Hope. [1960] [1]p. (AFOSR-3640) (AF 61(052)71)
Unclassified

Also published in Acta Chem. Scand., v. 14: 765, 1960.

The crystal structures of the salts $DM_\gamma PHBr$, $DM_\gamma PHBr \cdot H_2O$, $DM_\gamma PHBr \cdot 2H_2O$, and $DM_\gamma PHCl \cdot H_2O$ have been investigated by x-ray methods. Crystals of anhydrous $DM_\gamma PHBr$ are monoclinic — space group $P2_1/c$ — with a marked tendency towards twin formation. Cell dimensions are a = 6.98A; b = 15.52A; c = 15.51A; $\beta = 94.9°$; Z = 8 gives $\rho_{calc} = 1.65$ g/cm^3; $\rho_{obs} = 1.64$ g/cm^3. Crystals of the monohydrate $DM_\gamma PHBr \cdot H_2O$ are triclinic plates — space group p1 — with cell dimensions a = 7.00A; b = 8.33A; c = 9.47A; $\alpha = 109.9°$; $\beta = 92.9°$; $\gamma = 106.0°$; Z = 2 gives $\rho_{calc} = 1.50$ g/cm^3; $\rho_{obs} = 1.50$ g/cm^3. Dihydrate $DM_\gamma PHBr \cdot 2H_2O$ crystals are orthorhombic plates. The chloride $DM_\gamma PHCl \cdot H_2O$ is isomorphous with the corresponding HBr salt. More detailed structure determinations of these salts are under way.

1954

[Oslo U.] Inst. of Chemistry (Norway).

CRYSTAL STRUCTURE OF THE 1:1 MOLECULAR COMPOUND 1,4-DIOXAN, SULPHURIC ACID, by O. Hassel and Chr. Rømming. [1960] [9]p. incl. diagrs. tables. (AFOSR-3641) (AF 61(052)71) Unclassified

Also published in Acta Chem. Scand., v. 14: 398-406, 1960.

The 1:1 addition compound 1,4-dioxan, sulphuric acid crystallizes in the monoclinic system — space group $P2_1/c$ — with lattice parameters: a = 13.22A; b = 7.73A; c = 7.71A; $\beta = 92°$. Hydrogen bonds link each sulphuric acid unit to 2 neighboring dioxan molecules, thus producing endless chains of alternating dioxan and sulphuric acid molecules. Two sets of non-equivalent dioxan molecules are present in the structure, and 2 sets of hydrogen bonds are therefore also present. The lengths of these bonds are found equal to 2.51 and 2.59A, respectively. (Contractor's abstract)

1955

Oslo U. Inst. of Chemistry (Norway).

STRUCTURE OF THE CRYSTALLINE COMPOUND BENZENE-BROMINE (1:1), by O. Hassel and K. O. Strømme. [1958] [2]p. incl. diagrs. (AFOSR-3644) (AF 61(052)71) Unclassified

Also published in Acta Chem. Scand., v. 12: 1146-1147, 1958.

Single crystals of benzene-bromine were obtained and studied in a Weissenberg camera. From observed extinctions all space groups but C2/m, C2 and Cm could be excluded. Assuming a reasonable value of the density it follows that 2 molecules of either kind are contained in the unit cell. The bromine-bromine distance is 2.28A and the line joining the 2 bromine atoms is parallel to [101] and passes through the symmetry center of the benzene ring. The angle between this direction and the benzene plane is about 90°. The distance from each bromine atom to the adjacent benzene plane is 3.36A. Binding forces between the 2 components are weak indicated by a marked drop in x-ray intensities for increasing reflection angles.

1956

Oslo U. Inst. of Theoretical Astrophysics (Norway).

ON PLANE STATIONARY SHOCK WAVES IN PLASMA,

by K. Vøyenli. [1959] [88]p. incl. diagrs. refs. (Scientific rept. no. 3) (AFOSR-TN-60-424) (AF 61(052)-49) AD 236337; PB 152656 Unclassified

Equations for plane stationary shocks in a plasma are developed from a general continuum description of a fully ionized plasma consisting of 1 type of ions and electrons. The shock equations are independent of the viscosity and the thermal and electric conductivity of the plasma. When the magnetic field and the flow velocity are perpendicular to the shock front, the equations are reduced to the familiar form for an ordinary gas. When the magnetic field is parallel to the shock front or parallel shock, a strong formal analogy exists with the non-magnetic case. Several important results may consequently be transferred directly from the theory of shocks for ordinary gases. Consideration was given to the general case where the magnetic field forms an arbitrary angle with the shock front or oblique shock. An interesting special case, which has been disregarded during important parts of the previous treatment in this work, occurs when the Alfvén velocity behind the shock front is equal to the flow velocity behind and normal to the shock front. A wave type, identified as an Alfvén wave, may then appear. The only quantities which are changed by the shock transition for this wave type are the components of the magnetic field and the flow velocity parallel to the shock front. The magnetic field was shown to lose its importance for the motion when the shock is strong, and that a weak shock may be considered as a parallel shock. Finally the structure of parallel, hydromagnetic and non-magnetic shocks in a hydrogen plasma are discussed. The shock width is considerably greater than for an ordinary gas. As a result of the Hall effect an electric double layer will occur in the structural region. (Contractor's abstract)

1957

Oslo U. Inst. of Theoretical Astrophysics (Norway).

ON OSCILLATIONS IN AN ELECTRON PLASMA, by A. Kildal. [1959] [29]p. incl. diagrs. refs. (Scientific rept. no. 4) (AFOSR-TN-60-687) (AF 61(052)49) AD 244352 Unclassified

The integral expression for the dispersion relation of plane waves moving through a plasma is considered. The results may be obtained by expressing the perturbation in electron density in 2 different ways: (1) using the ordinary equation of motion and (2) using proper Maxwellian equations. Elimination of the density variation from both equations yields the desired dispersion relation. The same method is applied to the case when an external magnetic field is present. The dispersion relation as found by solving Boltzmann's equation is then obtained, and the frequency gaps are studied. (Contractor's abstract)

1958

Oslo U. Inst. of Theoretical Astrophysics (Norway).

ON THE DYNAMICS OF PROMINENCES AND CORONAL CONDENSATIONS, by E. Jensen. [1960] [19]p. incl. diagrs. tables, refs. (Scientific rept. no. 2) (AFOSR-TN-60-939) (AF 61(052)49) AD 244350 Unclassified

Also published in Astrophys. Norvegica, v. 6: 93-111, 1959.

Various possibilities for the formation of prominences and coronal condensations are discussed. A brief description is given of the general physical properties of the corona and coronal formations. The behavior of a plasma in a magnetic field having a weak inhomogeneity is analysed. It is shown that when a plasma is not in thermal equilibrium, with $\Delta = E - 2E_{\parallel} \neq 0$, an inhomogeneous magnetic field will have an influence upon the density-distribution in the plasma. When $\Delta > 0$ the plasma behaves like a diamagnetic medium, being pushed to places where the magnetic field is smallest. When $\Delta < 0$, the plasma behaves like a paramagnetic medium moving towards regions of larger field strength. $\Delta \neq 0$ is supposed to be maintained by changes in the magnetic field with time. Depending upon the value of the characteristic scale of the inhomogeneity, the required time-constant for the variations in the field comes out as 30 to 10^4 sec. The consequences for the formation and dynamics of prominences and coronal condensations are briefly discussed. (Contractor's abstract)

1959

Oslo U. Inst. of Theoretical Astrophysics (Norway).

ON THE EFFECT OF A MAGNETIC FIELD UPON EXTREMELY LOW FREQUENCY (ELF) WAVE PACKETS, by Ø. Holter. [1960] [15]p. incl. diagrs. (Scientific rept. no. 5) (AFOSR-TN-60-940) (AF 61(052)49) AD 244351 Unclassified

Also published in Astrophys. Norvegica, v. 6: 131-145, 1959.

An expression on a form analogous to the Appleton-Hartree formula for the refractive index is evaluated when the plasma has different components. At extremely low frequencies the best approximation to the exact formula is the quasi-transverse approximation, and not the quasi-longitudinal approximation as in the Appleton-Hartree theory. When it is possible to calculate the path of the extraordinary wave-packets in the quasi-transverse approximation, it results that the path coincides with the magnetic lines of force. Thus, the more the region where this approximation is valid increases (by lowering the frequency of the wave), the more the packets are guided along the lines of force. No such guiding is present in the ordinary mode. (Contractor's abstract)

1960

Oslo U. Neurophysiological Lab. (Norway).

EFFECTS OF CHLORPROMAZINE ON THE COMMISSURAL POTENTIAL OF THE FIELD CA1 OF THE HIPPOCAMPUS, by J. Setekleiv, P. Andersen and

others. [1960] [8]p. incl. diagrs. (AFOSR-TN-60-1106) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)1127 and Norwegian Research Council for Science and the Humanities) AD 243230 Unclassified

Also published in Acta Pharmacol. and Toxicol., v. 16: 357-363, 1960.

The effects of chlorpromazine (1-10 mg/kg intravenously) on the commissural potential of the field CA1 of the hippocampus have been studied in rabbits which were immobilized by decamethonium or anesthetized by urethane-chloralose. Chlorpromazine produced a short-lasting depression of all parts of the potential, followed by a period of augmentation. An initial increase of the amplitude of the potential was often encountered. The depression of the potential was paralleled by a drop of the systemic blood pressure. The effect on the hippocampal potential is regarded as due to the blood pressure changes and not to a specific action of chlorpromazine on the CA1 pyramidal neurons. (Contractor's abstract)

1961

Oslo U. Neurophysiological Lab. (Norway).

EFFECTS OF CHLORPROMAZINE ON THE "ATTENTION" (ORIENTING), FLIGHT AND ANGER RESPONSES ELICITED BY CEREBRAL STIMULATION, by B. R. Kaada and H. Bruland. [1960] 2p. (AFOSR-TN-60-1107) [AF 61(514)1127] AD 243231 Unclassified

Presented at Tenth Scandinavian Cong. of Physiology, Oslo (Norway), Aug. 22-24, 1960.

Also published in Acta Physiol. Scand., v. 50: Suppl. 175: 81-82, 1960.

The effects of chlorpromazine on the behavioral arousal associated with contralateral searching movements (the "attention" or orienting response) induced in unanesthetized cats from the cerebral cortex, amygdala and intralaminar thalamic nulcei have been studied and the results have been compared with the effect on the arousal responses elicited from mesencephalic reticular and posterior hypothalamic areas. Chlorpromazine was found to exert a selective depressant action on certain behavioral arousal reactions. The arousal related to the attention (orienting) response evoked by cortical, intralaminar thalamic, amygdaloid, and peripheral sensory stimulation is more susceptible to the drug than is the arousal associated with fear (flight) and anger elicited from the subcortical areas mentioned. As to the clinical implications of these observations, blocking of the attention response to sensory stimuli may explain the indifference to environmental and visceral stimuli and to pain in patients treated with chlorpromazine. Similarly, blocking of the centrally induced attention reactions may account for the relief of anxiety, agitation and tension, and for the reduced responsiveness to intrapsychic stimulation, such as to hallucinations.

1962

Oslo U. Neurophysiological Lab. (Norway).

BLOCKING OF THE CORTICALLY INDUCED BEHAVIORAL ATTENTION (ORIENTING) RESPONSE BY CHLORPROMAZINE, by B. R. Kaada and H. Bruland. [1960] [21]p. incl. diagrs. refs. (AFOSR-TN-60-1108) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)1127 and Norwegian Research Council for Science and the Humanities) AD 243232 Unclassified

Also published in Psychopharmacologia, v. 1: 372-388, Sept. 1960.

The behavioral arousal associated with contralateral searching movements (the attention or orienting response) induced by cerebral cortical stimulation in unanesthetized cats was blocked by low doses of chlorpromazine (0.5 mg/kg i.p.). Amounts of 2 mg/kg or more, were usually required to depress the similar response elicited from amygdaloid and intralaminar thalamic nuclei, whereas the threshold for the behavioral arousal evoked by midbrain reticular stimulation remained essentially unaltered with doses up to 10 mg/kg. Behavioral arousal associated with fear (flight) or anger produced by posterior hypothalamic, thalamic, or midbrain reticular stimulation was almost unaltered at doses of 10 to 15 mg/kg of chlorpromazine. It is concluded that chlorpromazine exerts a selective depressant action on certain behavioral arousal reactions. The arousal related to the attention (orienting) response evoked by cortical, intralaminar thalamic, amygdaloid, and peripheral sensory stimulation is more susceptible to the drug than is the arousal associated with fear (flight) and anger elicited from the subcortical areas mentioned. (Contractor's abstract)

1963

Oslo U. Neurophysiological Lab. (Norway).

INCREASE OF PLASMA 17-HYDROXYCORTICOSTEROIDS BY CEREBRAL CORTICAL AND AMYGDALOID STIMULATION IN THE CAT, by J. Setekleiv, O. E. Skaug, and B. R. Kaada. [1960] [2]p. (AFOSR-TN-60-1109) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)1127 and Norwegian Research Council for Science and the Humanites) AD 243233 Unclassified

Also published in Jour. Endocrinol., v. 22: 119-127, 1961.

Behavioral arousal and fear may be induced by electrical stimulation of the cingulate and the temporo-occipital cortex and the amygdala in the cat. The influence of these regions on the plasma level of 17-hydroxycorticosteroids (17-OHCS) has been studied. To eliminate the possibility that any increase observed was not secondary to arousal or fear caused by environmental factors or the blood sampling, the experiments were carried out under anesthesia. Increase of the plasma level of the 17-OHCS was produced by stimulation of 25 points in the following 3 regions: (1) the anterior cingulate cortex, (2) the lower portion of the posterior ecto- and suprasylvian gyri of the temporal-occipital

cortex, and (3) the amygdala. The increase ranged from 30 to 560% of control values, on an average of 154.4%. Stimulation of 37 points in other cortical regions and in the internal capsule caused no significant change in the plasma steroid level. (Contractor's abstract)

1964

Oslo U. Neurophysiological Lab. (Norway).

LOCAL CORTICAL RESPONSE OF THE RABBIT, by P. Andersen and J. Jansen, Jr. [1960] [1]p. (AFOSR-TN-60-1110) (AF 61(514)1127) AD 243234
Unclassified

Presented at Tenth Scandinavian Cong. of Physiology, Oslo (Norway), Aug. 22-24, 1960.

Also published in Acta Physiol. Scand., v. 50: Suppl. 175: 10-11, 1960.

The response of the field CA1 of the hippocampus evoked by local stimulation have been studied in rabbits under urethane-chloralose anesthesia. The CA1 local response consisted of an initial negative spike (1-3 msec), followed by a slower surface negative or negative/positive wave (25-60 msec) which sometimes had one or more negative spikes superimposed.

1965

Oslo U. Neurophysiological Lab. (Norway).

EFFECTS OF HIPPOCAMPAL LESIONS ON MAZE LEARNING AND RETENTION IN RATS, by B. R. Kaada, E. W. Rasmussen, and O. Kveim. [1960] [24]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1111) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)1127 and Norwegian Research Council for Science and the Humanities) AD 243235 Unclassified

Also published in Exper. Neurol., v. 3: 333-355, Apr. 1961.

Experiments were undertaken to determine whether hippocampal and formical lesions in rats have deleterious effects on maze learning and retention. A fourteen-choice multiple-T alley maze was employed. The effect on postoperative initial learning was studied in 52 rats. The animals with hippocampal or fornical lesions showed a significantly defective maze learning compared with the operated and non-operated controls in terms of total errors and time required to run the maze. Deficit in maze performance also followed removal of the mamillary bodies. The hippocampectomized rats suffered significant impairment in maze retention and relearning compared with the operated and controls. It was concluded that lesions of the hippocampus, fornix, and mamillary bodies seem to interfere with maze learning and retention, when incompletely trained preoperatively. The data obtained do not allow any conclusions as to how these structures are involved in learning and retention, neither as to their relative importance compared with other brain structures like neocortex or thalamus, both of which are previously known to influence learning and retention. (Contractor's abstract)

1966

Oslo U. Neurophysiological Lab. (Norway).

EFFECTS OF NEOCROTICAL AND LIMBIC LESIONS ON THE SEX DRIVE OF RATS, by E. W. Rasmussen, B. R. Kaada, and H. Bruland. [1960] [2]p. (AFOSR-TN-60-1112) [AF 61(514)1127] AD 243236
Unclassified

Presented at Tenth Scandinavian Cong. of Physiology, Oslo (Norway), Aug. 22-24, 1960.

Also published in Acta Physiol. Scand., v. 50: Suppl. 175: 126-127, 1960.

In the first part of the study the lesions were intentionally made relatively extensive. The results indicated that a decrease of the sex drive was produced by bilateral lesions of the fronto-parietal cortex of the lateral aspect of the hemispheres, or of the anterior temporal lobes. In subsequent experiments smaller bilateral lesions were made within these zones in order to attempt a further localization of any possible critical structures. Such were found (1) in the medial part of the fronto-parietal cortex, apparently corresponding to the upper part of the sensorimotor areas, and (2) in the amygdaloid nuclei. The number of crossings in the first as well as in the second postoperative tests was reduced to below one-third the original value. A persistent increase of the sex drive, in some animals amounting to 400% in number of crossings, was found by lesions confined to the dorsal septal area. Similar effects resulted from bilateral removal of the dorsomedial part of the diencephalon. The crucial structure within this latter region cannot be determined from the present material. The stria meduilaris or the habenular nuclei were damaged bilaterally in all animals of this diencephalic group. There was no corresponding increase in the running activity as measured by the revolving drum technique pre- and postoperatively. On the contrary, in most of these rats a decreased running activity was recorded. No significant change of the heterosexual drive resulted from lesions of other cortical areas, including the cingulate gyrus, the hippocampus, and the entorhinal area.

1967

Oslo U. Neurophysiological Lab. (Norway).

ACTIVATION OF THE DENTATE AREA BY SEPTAL STIMULATION, by P. Andersen, H. Bruland, and B. R. Kaada. [1960] [14]p. incl. refs. (AFOSR-TN-60-1113) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)1127 and Norwegian Research Council for Science and the Humanities) AD 243237 Unclassified

Also published in Acta Physiol. Scand., v. 51: 17-28, 1961.

In rabbits under urethane-chloralose anesthesia potentials were recorded bilaterally from the dentate area in response to stimulation of the large-celled posterior part of the medial septal nucleus. The septo-dentate response consisted of an initial negative spike followed by a slower positive wave. On the basis of recordings from the various cell layers, excitability properties, resistance to anoxia and repetitive stimulation, the initial spike is interpreted as discharges of the dentate granule cells, monosynaptically excited. The following positive wave may partly represent the subsequent spread of excitation into the dendrites of the granule cells, and partly the activation of CA4 neurons. Stimulation of the contralateral field CA3 of the hippocampus evoked within the dentate area a potential similar in form, but with a greater amplitude and shorter latency than the septo-dentate response. The crossed CA3-dentate potential is similarly most likely due to activation of the same granule cells. The crossed projection appears to be more efficient and consists of thicker fibers than the septo-dentate path. (Contractor's abstract)

1968

Oslo U. Neurophysiological Lab. (Norway).

ACTIVATION OF THE FIELD CA1 OF THE HIPPOCAMPUS BY SEPTAL STIMULATION, by P. Andersen, B. R. Kaada, and H. Bruland. [1960] [13]p. incl. refs. (AFOSR-TN-60-1114) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)-1127 and Norwegian Research Council for Science and the Humanities) AD 243238 Unclassified

Also published in Acta Physiol. Scand., v. 51: 29-40, 1961.

In rabbits under urethane-chloralose anesthesia the existence of a septo-hippocampal projection was verified by the evoked potential method. Its origin is the magnocellular medial septal nucleus. These septofugal fibers activate the basal parts of the apical dendrites and/or the soma of the CA1 neurons, probably by a monosynaptic route. By repetitive stimulation and by strychnine the depolarized area of the CA1 neurons may increase, by anoxia it may decrease. Thus, according to the excitability level, a smaller or greater part of the apical dendrites may initiate spikes of an all-or-none character. (Contractor's abstract)

1969

Oslo U. Neurophysiological Lab. (Norway).

THE LOCAL CORTICAL RESPONSE IN THE HIPPOCAMPUS OF RABBIT, by P. Andersen and [illegible] Jansen, Jr. [1960] [19]p. incl. refs. (AFOSR-TN-60-1115) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)1127 and Norwegian Research Council for Science and the Humanities) AD 243239 Unclassified

Also published in Arch. Ital. Biol., v. 99: 349-368, 1961.

The local response of the field CA1 of the hippocampus was studied in rabbits under urethane-chloralose anesthesia. The response consisted of an initial negative spike (1-3 msec) followed by a slower surface negative wave (25-60 msec), sometimes with 1 or more negative spikes superimposed. The response is assumed to be evoked by the direct electrical stimulation of pyramidal cell bodies or the initial part of their axons. It was recorded from a rather small, wedge-shaped zone extending from the stimulated point rostrally and somewhat laterally towards the fimbria. The maximal distribution of the negative wave was a little lateral to that of the initial spike. The conduction velocity of the latter was 1.3-3.3 m/sec. The initial spike is regarded as the postsynaptic discharge of the pyramidal cells. The activation takes place at the level of the cell body and is propagated into the apical dendritic shaft with a velocity of about 0.5 m/sec, decreasing to about 0.2 m/sec just before the site of the conduction block. The terminal arborization of the apical dendrites was apparently not invaded. The surface negative wave reversed its polarity just above the pyramidal layer. It is attributed to the synaptic activation of the basal dendrites. If this activation becomes sufficiently intense, late spikes occur as the sign of polysynaptic initiated pyramidal cell discharges. These secondarily activated pyramidal cell discharges are also propagated into the apical dendrites, but are blocked closer to the cell body than is the monosynaptically activated initial spike. The results are discussed in relation to the local responses of the neocortex and the cerebellar cortex. (Contractor's abstract)

1970

Oslo U. Neurophysiological Lab. (Norway).

SUBCORTICAL STRUCTURES MEDIATING THE ATTENTION RESPONSE INDUCED BY AMYGDALA STIMULATION, by H. Ursin and B. R. Kaada. [1960] [14]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1297) (AF 61(514)1127) AD 246203 Unclassified

Also published in Exper. Neurol., v. 2: 109-122, Apr. 1960.

Electrical stimulation of the amygdaloid nuclear complex in unanesthetized freely moving cats elicits a characteristic searching or attention response. Attempts have been made by combined stimulation-ablation techniques to determine the subcortical structures through which this response is mediated. The only lesion which eliminated the attention response was an almost complete vertical circumcision of the amygdala with interruption of the connections irradiating in the anteromedial, medial, and posteromedial directions. Selective section of any of these connections by lesions placed either anteromedially, medially, or postmedially to the amygdala, in various combinations were ineffective. It is concluded that the attention response is mediated through several pathways to wide-spread subcortical areas. Bilateral lesions of various subcortical nuclei onto which the amygdala is known to project did not abolish the attention response. Such lesions destroyed in various combinations the almost entire thalamus (including all mid-line and intralaminar nuclei), the subthalamus, extensive parts of the hy-

hypothalamus (including nucleus ventromedialis), and the preoptic area, the septal nuclei, the reticular formation, and the rostral half of the periaquaeductal gray matter of the midbrain, the pretectal area, the superior colliculi, the habenula, the substantia nigra, and the red nuclei. It is suggested that the amygdaloid attention response is mediated through several of these subcortical areas which could not be eliminated in toto in one and the same animal, because such extensive lesions were not compatible with survival. (Contractor's abstract)

1971

Oslo U. Neurophysiological Lab. (Norway).

[FUNCTIONAL SIGNIFICANCE OF TEMPORAL LOBE CENTERS IN THE BRAIN]; DISCUSSION, by B. R. Kaada. [1958] [8]p. incl. diagrs. refs. (AFOSR-TN-60-1345) [AF 61(514)1127] AD 254269 Unclassified

Also published in Neuropsychopharmacology; Proc. of the First Internat'l. Congress of Neuropharmacology, Rome (Italy) (Sept. 1958), New York, Elsevier Publishing Co., 1959, p. 38-45.

Studies are described which test the effect of various psychotropic drugs for their principal site of action on limbic structures as well as on the hypothalamic and the brain stem reticular formations. Anatomical and physiological research fractionates the various limbic structures into units with different projections and functions. Some of the more recent functional localization studies are briefly summarized. Various drugs are used and the conclusions reached are presented.

1972

Oxford U. Dept. of Biochemistry (Gt. Brit.).

THE METABOLISM OF C_2 COMPOUNDS IN MICROORGANISMS. IV. SYNTHESIS OF CELL MATERIALS FROM ACETATE BY ASPERGILLUS NIGER, by J. F. Collins and H. L. Kornberg. [1960] [9]p. incl. diagrs. tables, refs. (AFOSR-883) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)1180 and Rockefeller Foundation) AD 256183 Unclassified

Also published in Biochem. Jour., v. 77: 430-438, Dec. 1960.

The main purpose of this paper is to show that Aspergillus niger growing on acetate as sole carbon source incorporates isotope from (2-C^{14}) acetate in a manner which excludes the primary formation of succinate from acetate and which indicates that the required syntheses of intermediates of the tricarboxylic acid cycle are effected via the glyoxylate cycle. Cell-free extracts contain a high activity of the requisite enzymes of the glyoxylate cycle and can catalyse the net formation of malate and succinate from acetyl-coenzyme A and isocitrate. Extracts of Aspergillus niger, grown on substrates the metabolism of which does not necessitate such syntheses of C_4 compounds from acetate, are virtually devoid of a key enzyme of the glyoxylate cycle, isocitratase: this supports the view that that cycle plays an essential role in growth on acetate.

1973

Oxford U. Dept. of Biochemistry (Gt. Brit.).

MICROBIAL OXIDATION OF GLYCOLLATE VIA A DICARBOXYLIC ACID CYCLE, by H. L. Kornberg and J. R. Sadler. [1960] [6]p. incl. diagr. refs. (AFOSR-TN-60-450) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)180 and Rockefeller Foundation) AD 241939 Unclassified

Also published in Nature, v. 185: 153-155, Jan. 16, 1960.

A postulated dicarboxylic acid cycle for the oxidation of glycollate and glyoxylate is supported by studies on the growth of the E. coli mutant M22-64 (Jour. Biol. Chem., v. 222: 307, 1957) on oxidations effected by washed suspensions of the organism, and on enzymic reactions catalyzed by extracts obtained after disintegration of the organism in a magnetostrictor oscillator. Enzyme reactions, their influence on the bacterial cycle and the findings made in the investigation are listed. The oxidative dicarboxylic acid cycle shown represents a quantitatively important route for the microbial oxidation of carbon compounds at the oxidation-levels of glycollate or glyoxylate.

1974

Oxford U. Dept. of Biochemistry (Gt. Brit.).

CARBON ASSIMILATION BY PSEUDOMONAS OXALATICUS (OX 1). III. OXALATE UTILIZATION DURING GROWTH ON OXALATE, by J. R. Quayle and D. R. Keech. [1959] [9]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1298) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)180 and Rockefeller Foundation) AD 243206 Unclassified

Also published in Biochem. Jour., v. 75: 515-523, June 1960.

The incorporation of carbon atoms from (C^{14}) oxalate, (C^{14}) formate or (C^{14}) bicarbonate into the aqueous ethanol-soluble fraction of Pseudomonas oxalaticus (OX 1) grown on oxalate is studied. Only the isotope from (C^{14}) oxalate appeared in appreciable quantities in the aqueous ethanol-soluble fraction of the cells during 10 min incubation periods. It is shown that carbon dioxide-fixation processes, similar to those found to occur during growth of the organism on formate, do not have an important role in growth on oxalate. The conclusion is supported by the findings that carboxydismutase and phosphoribulokinase are synthesized during growth on formate but not except under special conditions during growth on oxalate.

1975

Oxford U. Dept. of Biochemistry (Gt. Brit.).

ENZYMIC FORMATION OF CITRAMALATE FROM ACETYL-COENZYME A AND PYRUVATE IN PSEUDOMONAS OVALIS CHESTER, CATALYSED BY PYRUVATE TRANSACETASE, by C. T. Gray and H. L.

Kornberg. [1960] [2]p. incl. tables. (AFOSR-TN-60-1441) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)180, Public Health Service, and Rockefeller Foundation) AD 253838 Unclassified

Also published in Biochim. et Biophys. Acta, v. 42: 371-372, 1960.

Cell-free extracts of Ps. ovalis Chester, which had been grown aerobically on itaconate as sole carbon source catalyzed the anaerobic incorporation if isotope from [2-C^{14}] acetatate into citramalate, if fortified with M_gCl_2, ATP, CoA and pyruvate. The incorporation rate is shown by measuring the radioactivity of the citramalate (counts/min x 10^{-4}). The formation of [C^{14}] citramalate from acetyl-coenzyme A and [3-C^{14}] pyruvate is indicated similarly. The catalyst is designated as "pyruvate transacetase".

1976

Oxford U. Dept. of Biochemistry (Gt. Brit.).

ISOCITRATASE AS AN ENZYMIC INDICATOR OF METABOLIC PATHWAYS, by H. L. Kornberg. [1960] [3]p. incl. diagr. table, refs. (AFOSR-250) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)180, Public Health Service and Rockefeller Foundation) AD 611292 Unclassified

Also published in Nature, v. 188: 488-489, Nov. 5, 1960.

Lysine is catabolized via pipecolic and α-amino-adipic acids to glutaric acid. Pseudomonas ovalis Chester were studied in order to determine the metabolic path of lysine. The isocitratase activity of extracts of these cells were measured. Growth of the first 5 carbon sources was accompanied ;by high and uniform levels of isocitratase, which indicates that their catabolism led chiefly to acetate. Growth on 3 of its substrates led to the formation of only traces of the enzyme. This latter pathway was ruled out as being quantitatively unimportant for this organism. The acetate end product is indicative of a β-oxidation rather than an α-oxidation pathway for glutaric acid.

1977

Oxford U. Dept. of Biochemistry (Gt. Brit.).

PURIFICATION AND PROPERTIES OF MALATE SYNTHETASE, by G. H. Dixon, H. L. Kornberg, and P. Lund. [1959] [17]p. incl. diagrs. tables, refs. (AFOSR-323) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)180 and Rockefeller Foundation) Unclassified

Also published in Biochim. et Biophys. Acta, v. 41: 217-233, July 1, 1960.

Procedures are described for the purification of malate synthetase from. baker's yeast and from glycollate-grown Pseudomonas ovalis Chester. The properties of the enzymes are similar: both optimally active at pH 8.5, but that from yeast shows greater activity below this pH than that from Pseudomonas ovalis. The enzymes require Mg^{+2} for activity and are competitively inhibited by the C_2-acids oxalate, fluoroacetate, and glycollate. The purified enzymes are specific for glyoxylate and do not catalyse the cleavage of acetyl-S-CoA in the presence of oxaloacetate, pyruvate, α-ketoglutarate, glyoxal, glycolaldehyde, formaldehyde, or actaldehyde. In the presence of glyoxylate, there is no reaction with S,N-diacetyl β-mercaptoethylamine, S-acetyl pantetheine, proplonyl coenzyme A or butyryl coenzyme A, but fluoroacetyl coenzyme A was split at approximately one quarter of the rate observed with similar concentrations of acetyl-S-CoA. Malyl-S-CoA was not split by the enzymes, either alone or in the presence of glyoxylate. The equilibrium of the reaction strongly favors malate formation; no reversal of the reaction was detected. Procedures are described for the preparation of (S^{35}) coenzyme A, which was used to test for the possible formation of an acyl enzyme as an intermediate in the malate synthetase reaction. The non-enzymic isotopic exchange of S^{35} from $CoAS^{35}H$ with acetyl-S-coenzyme A observed was not affected by the presence of malate synthetase. The properties of malate synthetase are compared with those of the citrate-forming condensing enzyme. (Contractor's abstract)

1978

Oxford U. Dept. of Biochemistry (Gt. Brit.).

THE FORMATION OF ISOCITRATASE BY THE ANTHIORHODACEAE, by H. L. Kornberg and J. Lascelles. [1960] [7]p. incl. diagrs. tables, refs. (AFOSR-324) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)180 and Rockefeller Foundation) AD 258873 Unclassified

Also published in Jour. Gen. Microbiol., v. 23: 511-517, Dec. 1960.

Isocitratase, which cleaves isocitrate to glyoxylate and succinate and is a key enzyme in the glyoxylate cycle, is formed by Rhodopseudomonas palustris and R. capsulatus when grown on acetate or butyrate either anaerobically in light or aerobically in the dark. Only traces of the enzyme are present in organisms grown on succinate or malate. In contrast, isocitratase is detectable in traces only in R. spheroides and Rhodospirillum rubrum grown on acetate, butyrate or other substrates. This suggests that the glyoxylate cycle cannot account for net synthesis of cell constituents from acetate or acetate precursors in these latter 2 organisms. (Contractor's abstract)

1979

Oxford U. Dept. of Biochemistry (Gt. Brit.).

THE METABOLISM OF C_2 COMPOUNDS IN MICRO-ORGANISMS. VI. SYNTHESIS OF CELL CONSTITUENTS

FROM GLYCOLLATE BY PSEUDOMONAS SP., by H. L. Kornberg and A. M. Gotto. [1960] [14]p. incl. diagrs. tables, refs. (AFOSR-325) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)180 and Rockefeller Foundation) AD 258874 Unclassified

Also published in Biochem. Jour., v. 78: 69-82, Jan. 1961.

Washed suspensions of Pseudomonas grown on glycollate, readily oxidized glycollate, glyoxylate, glycerate, pyruvate and malate. Of these, only malate was readily oxidized by the organism grown on succinate. Pseudomonas growing on glycollate incorporated C^{14} from (2-C^{14})glycollate most rapidly into glycine, phosphoglycerate and malate. Extracts of such cells catalysed the oxidation of glycollate to glyoxylate, which was stimulated by phenazine methosulphate. Such extracts further catalysed the anaerobic condensative decarboxylation of glyoxylate to carbon dioxide and a C_3 compound which was probably tartronic semialdehyde. This semialdehyde was reduced to glyceric acid with the stoichiometric oxidation of DPNH. Extracts of the glycollate-grown Pseudomonas catalysed the incorporation of isotope from (2-C^{14})glycerate into pyruvate, and the net formation of pyruvate from glycerate, if fortified with catalytic quantities of ATP. Such extracts also catalysed the oxidation of pyruvate and the formation of malate from acetyl-coenzyme A and glyoxylate. It is concluded that the oxidation of glycollate by Pseudomonas proceeds at least in part via a dicarboxylic acid cycle.

1980

Oxford U. Dept. of Biochemistry (Gt. Brit.).

THE METABOLISM OF C_2 COMPOUNDS IN MICRO-ORGANISMS. V. BIOSYNTHESIS OF CELL MATERIALS FROM ACETATE IN ESCHERICHIA COLI, by H. L. Kornberg, P. J. R. Phizackerley, and J. R. Sadler. [1960] [8]p. incl. diagrs. tables, refs. (AFOSR-326) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)180 and Rockefeller Foundation) AD 258875 Unclassified

Also published in Biochem. Jour., v. 77: 438-445, Dec. 1960.

The purpose of this paper is to show that isotope from (1-C^{14})acetate is incorporated into cellular materials by E. coli strain w, growing on acetate, in a manner consistent with the simultaneous operation of the tricarboxylic acid and glyoxylate cycles, and that extracts of such cells contain the requisite enzymes in high activity. No evidence for the postulated successive carboxylation of acetate or for the direct formation of succinate was obtained. Since this latter finding might have been due to species differences, the experiments were repeated with E. coli, Crooks strain. The results obtained again exclude this direct formation of succinate from acetate. They support the view that acetate is catabolized via the tricarboxylic acid cycle, and that the glyoxylate cycle operates as a means of supplying intermediates to that cycle.

1981

Oxford U. Dept. of Biochemistry (Gt. Brit.).

ON THE MECHANISM OF α-OXOGLUTARATE OXIDATION IN ESCHERICHIA COLI, by L. P. Hager and H. L. Kornberg. [1960] [5]p. incl. diagrs. table, refs. (AFOSR-327) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)180, Public Health Service, and Rockefeller Foundation) AD 258876 Unclassified

Also published in Biochem. Jour., v. 78: 194-198, Jan. 1961.

Cell-free extracts of the succinate-requiring mutant of E. coli and of its parent wild type were tested for their ability to catalyse reactions involved in the overall oxidation of α-oxoglutarate to succinate. Extracts of the wild type catalysed the reduction of DPN in the presence of α-oxoglutarate, thiamin pyrophosphate, and coenzyme A; extracts of the mutant did not. Addition of the mutant extract to that of the wild type did not affect the latter's ability to oxidize the alpha compound, indicating that the mutant's inability was not due to the presence of an inhibitor but to the lack of the α-oxoglutarate-dehydrogenase system. Extracts of the wild type catalysed the anaerobic evolution of carbon dioxide from α-oxoglutarate in the presence of thiamin pyrophosphate and ferricyanide as electron acceptor at a rate proportional to the amounts of extract added. Extracts of the mutant failed to effect this reaction. Extracts of the wild type organism in the presence of thiamin pyrophosphate catalysed the incorporation of isotope from (C^{14})bicarbonate into α-oxoglutarate, by isotopic exchange. Extracts of the mutant did not catalyse this reaction. Both types of extracts contained succinic thiokinase, lipoic dehydrogenase and lipoic trans-succinylase. These results show that the mutant lacks the enzymes catalysing the first step or first 2 steps in the overall oxidation of α-oxoglutarate. It is also shown that the mutant has the ability to grow anaerobically even in the absence of succinate.

1982

Oxford U. Dept. of Biochemistry (Gt. Brit.).

CARBON ASSIMILATION BY PSEUDOMONAS OXALATICUS (OX 1). IV. METABOLISM OF OXALATE IN CELL-FREE EXTRACTS OF THE ORGANISM GROWN ON OXALATE, by J. R. Quayle, D. B. Keech, and G. A. Taylor. [1960] [12]p. incl. diagrs. tables, refs. (AFOSR-499) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)180, Public Health Service, and Rockefeller Foundation) AD 254447 Unclassified

Also published in Biochem. Jour., v. 78: 225-236, Feb. 1961.

Reactions of oxalate, glyoxylate, formate and bicarbonate

in cell-free extracts of Pseudomonas oxalaticus (OXI) grown on oxalate have been studied. The extracts catalyse a decarboxylation of oxalate to formate which is dependent on catalytic quantities of succinate, adenosine triphosphate, coenzyme A and thiamine pyrophosphate. Magnesium ions and reduced glutathione accelerate the reaction. Succinate, adenosine triphosphate and coenzyme A can be replaced by catalytic quantities of succinyl-coenzyme A. The extracts catalyse the formation of succinyl-coenzyme A from succinate but no similar direct activation of oxalate, formate or acetate has been detected. During the decarboxylation of oxalate under the above experimental conditions both oxalylhydroxamic acid and formylhydroxamic acid have been isolated on addition of hydroxylamine, indicating the formation of coenzyme A esters of oxalic acid and formic acid. It is suggested that oxalyl-coenzyme A is synthesized by transferase action between succinyl-coenzyme A and oxalate. Oxalyl-coenzyme A is decarboxylated to formyl-coenzyme A, the coenzyme A grouping of which can be transferred back to oxalate either directly, or indirectly via succinate. Whole cells of Pseudomonas oxalaticus oxidize both formate and oxalate. The extracts catalyse a triphosphopyridine nucleotide- and coenzyme A-dependent oxidation of glyoxylate to oxalate. They also incorporate (C^{14})bicarbonate into malate and citrate in the presence of pyruvate and reduced TPN.

1983

Oxford U. Dept. of Biochemistry (Gt. Brit.).

CARBON ASSIMILATION BY PSEUDOMONAS OXALATICUS (OX 1). V. PURIFICATION AND PROPERTIES OF GLYOXYLIC DEHYDROGENASE, by J. R. Quayle and G. A. Taylor. [1960] [5]p. incl. diagrs. tables, refs. (AFOSR-884) (Sponsored jointly by Air Force Office of Scientific Research under AF 61-(052)180, Public Health Service, and Rockefeller Foundation) AD 258184 Unclassified

Also published in Biochem. Jour., v. 78: 611-615, Mar. 1961.

This paper records a purification of the enzyme obtained from Pseudomonas oxalaticus, with procedures of ammonium sulphate precipitation, gel absorption and ion-exchange chromatography, and an examination of its properties. This study shows that glyoxylic dehydrogenase is an enzyme specific for the oxidation of glyoxylate in the presence of TPN and CoA. The suggestion that the enzyme plays a key role in microbial growth on oxalate is further supported by its presence in oxalate-grown Pseudomonas OD1 and its decrease in activity to one-sixth when the organism is grown on malate.

1984

Oxford U. Dept. of Biochemistry (Gt. Brit.).

METABOLISM OF C_1 COMPOUNDS IN AUTOTROPHIC AND HETEROTROPHIC MICROORGANISMS, by J. R. Quayle. [1960] [34]p. incl. diagrs. tables, refs. (AF 61(052)180) Unclassified

Published in Ann. Rev. Microbiol., v. 15: 119-152, 1961.

The participation of C_1 units, including CO_2 in the microbial synthesis of C_2, C_3, and C_4 compounds is discussed. Special reference is given to the syntheses effected by microorganisms during their growth on such C_1 compounds as the sole carbon source. (Contractor's abstract)

1985

Oxford U. Dept. of Pharmacology (Gt. Brit.).

THE DECARBOXYLATION OF AMINO ACIDS RELATED TO TYROSINE AND THEIR AWAKENING ACTION IN RESERPINE-TREATED MICE, by H. Blaschko and T. L. Chruściel. [1959] [13]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1287) (AF 61(052)235) AD 246202 Unclassified

Also published in Jour. Physiol., v. 151: 272-284, May 1960.

The activity of the dopamine (DOPA) decarboxylase of the mouse on a number of amino acids related to tyrosine has been measured. Extracts of liver, kidney and brain decarboxylated not only L-DOPA, but also meta-tyrosine, 2:3-DOPA and 2:5-DOPA. The effect of the intraperitoneal administration of a number of amino acids on the motor activity of normal and reserpine-treated mice was studied. A method for the evaluation of the motor activity is described. L-DOPA and meta-tyrosine had strong awakening effects upon mice treated with reserpine. D-DOPA, 2:3-DOPA, 2:5-DOPA and threo-3:4-dihydroxyphenylserine had no awakening actions in reserpine-treated mice. (Contractor's abstract)

1986

Oxford U. Dept. of Pharmacology (Gt. Brit.).

THE INHIBITION OF HUMAN AMINE OXIDASE BY THE TWO ISOMERS OF AMPHETAMINE, by H. Blaschko and B. C. R. Strömblad. [1960] [3]p. incl. table. (AFOSR-TN-60-1288) (AF 61(052)235) AD 246205 Unclassified

Also published in Drug Research, v. 10: 327-329, 1960.

Homogenates of human salivary glands and of human brain were examined, and the inhibition of the enzymic oxidation of tyramine by the 2 isomers of amphetamine was studied. Amine oxidase from the human brain, from human parotid and submaxillary glands is inhibited by amphetamine. The dextrorotatory isomer is a stronger inhibitor of the enzyme than the laevorotatory isomer. (Contractor's abstract)

1987

Oxford U. Dept. of Pharmacology (Gt. Brit.).

OXIDATION OF 5-HYDROXYTRYPTAMINE AND RELATED COMPOUNDS BY MYTILUS GILL PLATES, by H. Blaschko and A. S. Milton. [1959] [5]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1289) (AF 61-(052)235) AD 246207 Unclassified

Also published in Brit. Jour. Pharmacol. and Chemotherapy, v. 15: 42-46, Mar. 1960.

Homogenates of gill plates of Mytilus edulis L. used oxygen when 5-hydroxytryptamine was added. The oxidation of 5-hydroxytryptamine was not due to the presence of an amine oxidase, but to that of an enzyme that catalysed the oxidation of other 5-hydroxyindoles (5-hydroxytryptophan, bufotenine). The oxidation was cyanide-sensitive, but was not inhibited by iproniazid. In the reaction a yellowish-brown substance was formed. The occurrence of an amine oxidase in the anterior retractor muscle of the byssus and in the digestive gland was confirmed. (Contractor's abstract)

1988

Oxford U. Dept. of Pharmacology (Gt. Brit.).

ENZYMIC OXIDATION OF PSILOCINE AND OTHER HYDROXYINDOLES, by H. Blaschko and W. G. Levine. [1959] [2]p. (AFOSR-TN-60-1290) [AF 61(052)235] AD 246204 Unclassified

Also published in Biochem. Pharmacol., v. 3: 168-169, May 1960.

It has recently been shown that the gill plates of Mytilus edulis L. contain an oxidase that acts on 5-hydroxyindoles, e.g. 5-hydroxytryptamine, bufotenine and 5-hydroxytryptophan. This report compares the enzymic oxidation of bufotenine with that of its 4-hydroxy and 6-hydroxy analogues. It was found that both hydroxyindoles are oxidized by the Mytilus preparation. The rate of oxidation of the 6-hydroxy derivative was similar to that of bufotenine. With psilocine, the 4-hydroxy, as substrate, oxygen uptake was more rapid than with bufotenine or with 5-hydroxytryptamine. In studying the N-I-methyl derivatives of both bufotenine and psilocine, it was found that the 5-hydroxy compound was oxidized at about the same rate as bufotenine; the N-I-methyl derivative of psilocine was oxidized more slowly than psilocine itself. These observations show that the substrates of the Mytilus oxidase are not restricted to 5-hydroxyindoles. The name "hydroxyindole oxidase" is therefore proposed by the authors.

1989

Oxford U. Dept. of Pharmacology (Gt. Brit.).

ENZYMIC OXIDATION OF 5-HYDROXYTRYPTAMINE BY PIG SERUM, by H. Blaschko and W. G. Levine. [1960] [3]p. incl. table. (AFOSR-736) [AF 61(052)-235] Unclassified

Published in Jour. Physiol., v. 154: 599-601, Dec. 1960.

The oxidation of 5-hydroxytryptamine (5-HT) by pig serum is studied. Methods used to fractionate the serum proteins are described. The results indicate that 5-HT is not a substrate of the amine oxidase present in the serum; and oxidation of 5-HT is catalyzed by caeruloplasmin, the copper-containing protein of plasma. This observation is due to a further purification of the plasma enzyme.

1990

Oxford U. Engineering Lab. (Gt. Brit.).

THE RADIATION RESISTANCE OF AN ELEMENTARY DIPOLE IN ANISOTROPIC PLASMAS. by H. Kogelnik. [1959] [13]p. incl. diagrs. refs. (Technical note no. 3) (AFOSR-TN-60-49) (AF 61(514)1183) AD 232082; PB 145669 Unclassified

Also published in Proc. Fourth Internat'l. Conf. on Ionization Phenomena in Gases, Uppsala (Sweden) (Aug. 17-21, 1959), Amsterdam, North Holland Publishing Co., v. 2: 721-725, 1960.

A theoretical study is made of the radiation resistance of and the power radiated by an elementary dipole and short antennas placed in anisotropic dielectric media, such as an ionized gas in a magnetic field. The dependence of these quantities on the dipole's orientation is the same as that of the inverse square root of the distance from the center to the surface of an ellipsoid of revolution. An integral representation for the 2 extreme values of the radiation resistance was obtained. For special cases of anisotropy, including the case of the uniaxial crystal, these integrals can be evaluated elementarily. For general anisotropy they were evaluated numerically for a set of parameters with the aid of an electronic computer. (Contractor's abstract)

1991

Oxford U. Engineering Lab. (Gt. Brit.).

TRANSVERSE COMPPESSION WAVES IN A 'STABILIZED' DISCHARGE, by D. Reagan. [1959] 15p. incl. diagr. (Technical note no. 4) (AFOSR-TN-60-279) (AF 61(514)1183) AD 234220; PB 147620 Unclassified

Also published in Phys. Fluids, v. 3: 33-39, Jan.-Feb. 1960.

An electric discharge which is compressed by its own magnetic field, and "stabilized" by means of an axial magnetic field, can transverse wave motions which cause its periodic compression and expansion. This kind of motion can cause the heating of the ions in the discharge. The simplest of these wave modes are described and an estimate is given of the power available to the waves as a result of the interaction of the electrons in the discharge with an axial electric field. This interaction can cause the attenuation or spontaneous

growth of the waves, depending upon the circumstances. It is likely that in high current gas discharge experiments there are examples of growing and decaying waves of this type.

1992

Oxford U. Engineering Lab. (Gt. Brit.).

HARMONICS FROM A MICROWAVE GAS DISCHARGE, by N. R. Bierrum and D. Walsh. [1960] [9]p. incl. diagrs. (Technical note no. 5) (AFOSR-TN-60-280) (AF 61(514)1183) AD 234219; PB 146441
Unclassified

Also published in Jour. Electronics and Control, v. 8: 81-90, Feb. 1960.

Harmonic power from a 10 cm wavelength glow discharge in neon was detected down to 6 mm wavelength (18th harmonic). The fundamental power is fed from the wavelength to a coaxial line terminated by the discharge tube. A second smaller waveguide is coupled to the coaxial line to extract the harmonic power. With careful matching at each wavelength, the conversion loss appears to fall off by only 3-4 db per harmonic after an initial drop of 35 db to the third harmonic (lowest harmonic measured). A typical conversion loss from 10 cm to 8 mm (12th harmonic) is 63 db, e.g. 20 kw input, 10 mw output. In general the output power increases with input power until arcing in the mount spoils the measurement. A pressure range of 5-39 mm Hg was used. (Contractor's abstract)

1993

Oxford U. Engineering Lab. (Gt. Brit.).

ELECTRO-MAGNETIC RADIATION IN ANISOTROPIC MEDIA, by H. Kogelnik. June 1960 [62]p. incl. diagrs. refs. (Technical note no. 6) (AFOSR-TN-60-1042) (AF 61(514)1183) AD 244283; PB 152418
Unclassified

A brief survey is presented of the material constants of anisotropic media like ionized gases, ferrites, etc. The conditions are studied which the elements of the tensor material constants of lossy (and lossless) media have to satisfy. Plane electro-magnetic waves in unbounded, loss and lossless anisotropic media are investigated. A general method is presented of solving radiation problems in unbounded homogeneous, anisotropic media, which involves dyadic Green's functions and their spatial Fourier transforms. Formulas are derived which give the power radiated by a distribution of alternating electric and/or magnetic currents in terms of the spatial Fourier transforms of the Green's functions and the currents. The method described is applied to the study of waves excited by oscillating dipoles arranged in a plane in an anisotropic medium - and particularly in a plasma. In another application an expression is obtained for the power transferred from a modulated flat beam of ions to the plasma into which it is being injected. The power radiated by an elementary electric dipole (Hertzian dipole) in a lossless plasma is studied in greater detail. The dependence of this power on the dipole's orientation and polarization can be described by means of a Hermitian matrix. (Contractor's abstract)

1994

Oxford U. Engineering Lab. (Gt. Brit.).

UNDULATOR EXPERIMENTS AND HARMONICS FROM A MICROWAVE GAS DISCHARGE, by H. Motz and D. Walsh. June 1960 [10]p. incl. illus. diagrs. (Technical note no. 7) (AFOSR-TN-60-1043) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(514)1183 and Royal Society) AD 244282
Unclassified

In the first part of this report experiments are reported on millimeter wave generation by means of an undulator. The electrons were accelerated by a 10 cm linear accelerator, consisting of a bunching section and a uniform section. Tests of the bunching of the electron beam showed that bunching occurred over distances less than 9 mm, but it was not effective at 4 mm. It was also demonstrated satisfactorily that the undulator radiation can rise to a value of approx one watt, or more, when the electron beam is suitably bunched. In the second part of this report, progress is reported on harmonics from a microwave gas discharge. The present stage of the work consists of measuring harmonics from an 8 mm discharge. Here the dimensions of the tubes are very critical. Thus far, measurements of the voltage across an open circuit crystal detector indicate a value of 2.5 v for the 2nd harmonic and 1 v for the 3rd harmonic. Assuming this latter corresponds to a few mw, the conversion loss is approx 60 db.

1995

Oxford U. Engineering Lab. (Gt. Brit.).

COHERENCE AND BAND-WIDTH OF A GAS DISCHARGE HARMONIC GENERATOR, by N. R. Bierrum, D. Walsh, and J. C. Vokes. [1960] [1]p. incl. diagr. (AFOSR-TN-60-1309) (AF 61(514)1183) AD 246219
Unclassified

Published in Nature, v. 186: 626, May 21, 1960.

Previous work has shown that a microwave gas discharge is an efficient harmonic generator and shows promise of producing a reasonable quantity of power in the 1-mm wave-length region. Two experiments, carried out to study the applicability of this harmonic generator in spectroscopy (especially if the radiation were narrow-band and coherent), are briefed. The results indicate that the harmonic generator output is coherent and narrow-band and that it is a true line source comparable to a reflex klystron.

1996

Oxford U. Engineering Lab. (Gt. Brit.).

GENERATION OF COHERENT MILLIMETRE WAVES,

by D. Walsh. [1960] iv. incl. illus. diagrs. tables, refs. (Technical note no. 8) (AFOSR-59[illegible] 4F 61-(514)1183) AD 258727 Unclassified

A survey is presented of possible applications of electromagnetic waves between the radio and infrared regions and methods of generating them. The theoretical and experimental background of 1 of these methods, the magnetic undulator is given. The apparatus and preliminary setting up of the electron accelerator is described. An experiment is presented in which power radiated by a short undulator is measured as a function of the electron beam current. It was found that a degree of coherence exists for radiation in the 8 mm band but not for shorter wavelengths. An experiment is also discussed with a large undulator, designed to give fundamental (lowest mode number) radiation in the 8 mm band. The power radiated (approx 0.5 w) is consistent with that predicted by theory for the current-power law. (Contractor's abstract)

1997

Oxford U. Engineering Lab. (Gt. Brit.).

STRONG FOCUSSING OF ELECTRON BEAMS WITH MAGNETIC UNDULATOR LENSES, by D. Walsh. [1960] [3]p. (AF 61(514)1183) Unclassified

Published in Proc. Symposium on Millimeter Waves, New York, N. Y. (Mar. 31-Apr. 2, 1959), Brooklyn, Polytechnic Inst. of Brooklyn Press [1960] p. 165-167.

A simple lens whose focussing is dependent on magnetic field gradient is described. A low voltage cylindrical electron beam is converted into a strip (elliptical) beam. This is advantageous for millimeter-wave tubes that have plane rf wave structures. A further advantage is that the current density is increased. (Contractor's abstract)

1998

Oxford U. Inorganic Chemistry Lab. (Gt. Brit.).

RECOMBINATION OF OXYGEN ATOMS IN THE GAS PHASE, by P. G. Dickens, R. D. Gould and others. Dec. 1960 [9]p. incl. diagrs. (AFOSR-TN-60-1016) (AF 61(514)1117) AD 254[illegible]60; PB 155689 Unclassified

Also published in Nature, v. 187: 686-688, 1960.

The kinetics of the recombination of oxygen atoms is studied. A flow system is used and the rate of the gas phase recombination of oxygen atoms is measured by the method of isothermal calorimetry. The decay process is found to be first order in oxygen atoms, but second order in oxygen molecules, in agreement with that of Schiff and supports his proposed mechanism (Canad. Jour. Chem., v. 37: 1680, 1959). A simplified model is presented of the kinetic picture by using modified assumptions for the equations and the associated parameters.

1999

Oxford U. Inorganic Chemistry Lab. (Gt. Brit.).

EMISSION SPECTRA OF FLAMES SUPPORTED BY ACTIVE NITROGEN, by K. R. Jennings and J. W. Linnett. Dec. 1960, 11p. incl. refs. (AFOSR-TN-60-1017) (AF 61(514)1117) AD 254361; PB 155690 Unclassified

Visible and ultraviolet emission spectra of flames produced by introducing 16 substances into a stream of active nitrogen have been photographed. The CN red and violet systems are the most prominent features of the spectra of flames given by hydrocarbons, and although the CH 4315A head is present, the CH 3889A head is not observed. A complex group of heads in the region of 3290A was also observed in the spectrum of hydrocarbon flames and this has been tentatively assigned to the cyanogen molecule or to a species formed from it. (Contractor's abstract)

2000

Oxford U. [Inorganic Chemistry Lab.] (Gt. Brit.).

STUDIES OF ATOMIC REACTIONS (Abstract), by J. W. Linnett. [1960] [2]p. (AF 61(514)1117) Unclassified

Presented at First AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, General Dynamics Corp., General Atomic Div., San Diego, Calif., Sept. 6-7, 1960. (AFOSR-TN-60-1063; AD 246174)

Part one of this research concerns atom recombination reactions at surfaces. These processes are found to be first order and a value is obtained for the ratio of the recombination coefficient (fractional number of collisions leading to recombination) to the diffusion coefficient. The second part deals with atom reactions in the gas phase which are found to be first order in the atomic oxygen concentration. A rate constant for the reaction $O + O_2 + O_2 = O_3 + O_2$ has been obtained which is somewhat higher than determined previously.



Palmer Physical Lab., Princeton, N. J. see Princeton U. Palmer Physical Lab., N. J.

Palomar Observatory, Pasadena, Calif. see California Inst. of Tech. Palomar Observatory, Pasadena.

2001

[Paris U. (France)]

X-RAY DIFFRACTION IMAGES OF A CRYSTALLINE SURFACE, by M. Cagnon and A. Guinier. Jan. 1960 [26]p. incl. illus. diagrs. table. (Technical note no. 2) (AFOSR-TN-60-681) (AF 61(052)51) AD 240359; PB 149568 Unclassified

The main purpose of the experiments described in this report is to explore in some particular cases the possibilities of x-ray images for the study of the defects in a crystal. The results may be summarized as follows: (1) The increase of the local reflecting power is due chiefly to the slight distortions existing around the atomic defects, which occur in a relatively large region (~1 μ). The detection of individual dislocation, is thus not possible, except in very perfect crystals, like Ge or Si. (2) X-ray methods are able to give other results, mainly about the deformations provoked by groups of dislocations. They are sensitive to the distribution and the interaction of dislocations. (3) The examination of a surface is perturbed by the very easy deteriorations of the crystal. The slightest scratches are visible on x-ray pictures. On the other hand, crystals of any thickness without preparation may be used. (4) It seems possible that quantitative measurements of the reflecting power can be made.

2002

Paris U. (France).

DYNAMICAL THEORY OF THE REFLECTION OF X-RAYS ON CURVED CRYSTALS (SYMMETRICAL BRAGG CASE), by D. Taupin. Final technical rept. Jan. 1960 [25]p. incl. diagrs. tables, refs. (AFOSR-TR-60-30) (AF 61(052)51) AD 234213; PB 146434 Unclassified

A dynamical theory built on the same basis as the Darwin theory is applied to perturbated crystals. It allows for a perturbation being regular and continuous, and depending on 1 geometrical coordinate. This coordinate is perpendicular to the reflecting planes and to the crystal surfaces, since only the symmetrical Bragg case is considered. It leads to a complex differential equation, which can only be numerically resolved. The case of a perturbation being a linear function of the coordinate is studied and a method is given for the calculation of the reflecting power in the general case when the displacement is a quadratic function of the 3 space coordinates. Numerical values are given for some reflections on silicon. Experiments are made and compared with theory, in the case of the 400 symmetrical Bragg case, of molybdenum radiation, on silicon for various cylindrical and elastical curvatures. Experimental results are in fair agreement with theoretical calculations and the differences are expected to be due to imperfections in the experimental sample. (Contractor's abstract)

2003

[Paris U. Lab. de Physique (France)].

EQUIVALENCE PRINCIPLE PARADOX IN THE MOTION OF A GYROSCOPE, by L. I. Schiff. [1960] [2]p. [AF 61(514)1061] Unclassified

Published in Nuovo Cimento, Series X, v. 17: 124-125, July 1, 1960.

An apparent violation of the equivalence principle that arises in connection with the precession of the spin axis of a gyroscope moving in a uniform gravitational field is described. The paradox is then resolved by a realistic specification of what is meant by the term uniform.

2004

[Paris U. Lab. de Physique Théorique et Hautes Energies] (France).

THE AXIAL VECTOR CURRENT IN BETA DECAY, by R. P. Feynman, M. Gell-Mann, and M. Levy. [1960] 29p. incl. refs. (Technical note no. 17) (AFOSR-TN-60-294) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)173 and Alfred P. Sloane Foundation) AD 234423; PB 146551 Unclassified

Also published in Nuovo Cimento, Series X, v. 16: 705-726, May 16, 1960.

In order to derive the formula of Goldberger and Treiman (Phys. Rev., v. 110: 1478, 1958) for the rate of charged pion decay, the possibility is considered that the divergence of the axial vector current in β decay may be proportional to the pion field. Three models of the pion-nucleon interaction (and the weak current) are presented which have the required property. The first using gradient coupling, has the advantage that it is easily generalized to strange particles, but the disadvantages of being unrenormalizable and of bringing in the vector and axial vector currents in an unsymmetrical way. The second model, using a strong interaction proposed by Schwinger and a weak current proposed by Polkinghorne, is renormalizable and symmetrical between V and A, but it involves postulating a new particle and is hard to extend to strange particles. The third model resembles the second one except that it is not necessary to introduce a new particle; however, renormalizability is in the usual sense then lost. (Contractor's abstract)

2005

Paris U. Lab. de Physique Théorique et Hautes Energies, (France).

ON THE THEORY OF CLASSICAL FLUIDS, by L.

Veriet. [1960] 34p. incl. diagrs. refs. (Technical note no. 18) (AFOSR-TN-60-689) (AF 61(052)173) AD 240348; PB 149589 Unclassified

Also published in Nuovo Cimento, Series X, v. 18: 77-101, Oct. 1, 1960.

The radial distribution function s(r) for classical fluids is determined. Knowing this function, the thermodynamical properties of homogeneous fluids in equilibrium can be deduced. Through the use of virial theorem, the equation of state is obtained: $p = \rho KT - (\rho^2/6) \int s(r) (\partial V(r)/\partial r) r\, dr$, where p is the pressure, ρ the density ($\rho = N/V$), K the Boltzmann constant, and T the absolute temperature. Attention is restricted to the case where V(r) is a spherically symmetric potential. An integral equation for the three-body correlation function in classical fluids is established. This equation contains a main equation which is simple and correction terms. The solution of the main equation is a non-linear equation. The equation is solved by using both the iteration procedure and a simple iterative process starting from the zero-density correlation function. In the low density, convergence is attained and both methods lead to the same result. In the high density region, the two approaches fail to converge.

2006

[Paris U. Lab. de Physique Théorique et Hautes Energies] (France).

RELATIVISTIC DEUTERON WAVE FUNCTION - II, by M. Gourdin. [1960] [21]p. incl. diagr. (Technical note no. 19) (AFOSR-TN-60-917) (AF 61(052)173) AD 242248; PB 150349 Unclassified

Also published in Nuovo Cimento, Series X, v. 18: 443-457, Nov. 1, 1960.

Research is continued on the deuteron relativistic wave function. Bethe and Salpeter's (Phys. Rev., v. 84: 1232, 1951) relativistic wave equation is applied to the bound system of two particles with spin 1/2. After some very slight approximations, the solution of the infinite system of coupled integral equations provides the explicit structure of the wave matrices corresponding to the S and D states. The percentage of D state obtained is in good agreement with the experimental result.

2007

Paris U. Lab. de Physique Théorique et Hautes Energies (France).

A MODEL FOR THE CALCULATION OF THE OPTICAL POTENTIAL IN SOME FINITE NUCLEI, by B. Jancovici. [1960] [26]p. incl. diagrs. table, refs. (Technical note no. 20) (AFOSR-TN-60-941) (AF 61-(052)173) AD 242249; PB 150352 Unclassified

Also published in Nuclear Phys., v. 21: 256-269, Nov. 1960.

The imaginary part of the optical potential is computed in second order in an harmonic oscillator shell model for He^4, O^{16}, Ca^{40}; finite nucleus shell model wave functions are consistently used. The results show a good agreement with those of the Thomas-Fermi approximation, providing a check for the validity of the latter. A stronger absorption; in the surface is predicted; this effect is therefore not a spurious effect of the Thomas-Fermi approximation. (Contractor's abstract)

2008

[Paris U.] Lab. de Physique Théorique et Hautes Energies (France).

RANGE OF PROTON-ANTIPROTON ANNIHILATION, by M. Lévy. Sept. 1960 [6]p. (Technical note no. 21) (AFOSR-98) (Also bound with its AFOSR-1829; AD 272440) (AF 61(052)173) AD 262331 Unclassified

Also published in Phys. Rev. Ltrs., v. 5: 380-381, Oct. 15, 1960.

The "maximum theorem" of Rarita and Schwed is generalized for the case when the absorptive region is surrounded by an attractive potential. The result, valid to first order in V, is $(\sigma_{tot})^2/\sigma_{el} \cong 4\pi R^2 \left(\frac{|V|}{E}\right)$. The antiproton cross-sections in the energy range from 200 mev to 2 bev "can be fitted quite well by taking $R = 1.43 \times 10^{-13}$ cm and $|V| = 38$ mev". If pion production without annihilation is the dominant inelastic process, this is quite a reasonable result, however, if the main contribution is from annihilation, the long range of the annihilation region remains a puzzle.

2009

Paris U. Lab. de Physique Théoretique et Hautes Energies (France).

ON THE EFFECTIVE INTERACTION IN FINITE NUCLEI, by B. Bremond. July 1960, 9p. incl. table. (Technical note no. 22) (AFOSR-385) (AF 61(052)173) AD 253280; PB 155426 Unclassified

Also published in Nuclear Phys., v. 22: 434-438, Feb. 1961.

The expectation values of the two-nucleon interaction are calculated using Brueckner's matrix and shell model wave functions. These values are compared with phenomenological ones. The discrepancies can be explained by the effected approximations. (Contractor's abstract)

2010

Pavia U. Ist. di Fisica (Italy).

ALPHA AND BETA BANDS IN KCl AND NaCl, by G.

Chiarotti, G. Giuliani, and D. W. Lynch. [1960] [3]p. incl. diagrs. tables. (AFOSR-134) [AF 61(052)-423] AD 252859 Unclassified

Also published in Nuovo Cimento, Series X, v. 17: 989-991, Sept. 16, 1960.

The α and β bands were observed in thin cleaved samples of Harshaw KCl and NaCl single crystals using a Hilger 1-m vacuum grating monochromator with a hydrogen capillary discharge as a source and a photomultiplier detector. The bands obtained at 95°K are described and discussed.

2011

Pennsylvania State U. Dept. of Aeronautical Engineering, University Park.

AN INVESTIGATION OF THE MACROSCOPIC EQUATIONS FOR A PLASMA, by H. Li and R. D. Mathieu. May 1960, 27p. incl. refs. (Technical rept. no. 13) (AFOSR-TN-60-1070) (AF 49(638)647) AD 263406; PB 153432 Unclassified

The macroscopic equations for the conservation of mass, momentum, and energy, which are deduced from the particle viewpoint by using the classical Boltzmann equation, are investigated for both a nonreacting plasma and a reacting plasma. The most general form of these equations is presented for variable material constants, i.e., dielectric constant and magnetic permeability. The resulting equations are compared with equations which were obtained from the continuum viewpoint of a control volume and a control surface for the plasma (Contractor's abstract)

2012

Pennsylvania State U. [Dept. of Aeronautical Engineering] University Park.

GASDYNAMICS OF PLASMA (Abstract), by H. Li and R. D. Mathieu. [1960] [1]p. (Bound with its AFOSR-TN-60-405; AD 235949) (AF 49(638)647) Unclassified

Presented at Third AFOSR Contractors' meeting on Ion and Plasma Propulsion, Republic Aviation Corp., Farmingdale, N. Y., Mar. 22-24, 1960.

The basic magnetogasdynamic equations can be derived by a continuum approach using a control volume and making use of known gross effects on the motion of the fluid contained in the control volume, or by a microscopic approach which considers the individual particles and then a statistical average is used to obtain the gross effects. The latter method, which consists of the classical kinetic theory using Boltzmann's equation, is used to study the macroscopic equations of magnetogasdynamics for a mixture of ionized gases. The basic continuity, momentum, and energy equations are presented as well as an equation of state and an expression for the generalized Ohm's Law. Special attention is given to the equation of state and the expression for the external electromagnetic force when the magnetic permeability and electric permittivity are not assumed to be constant but rather are considered as functions of the density and temperature of the fluid. An attempt is made to show the relationship between the total energy of the fluid and the mechanical and electromagnetic energies. This leads to a better understanding of the thermodynamic properties of a plasma. It is possible to modify the resulting equations to include the effects of chemical reactions.

2013

Pennsylvania State U. Dept. of Chemistry, University Park.

A STUDY OF THE ELECTRICAL CONDUCTIVITY AND THE SOLUBILITY OF THE SYSTEMS ALUMINUM CHLORIDE-TRICHLOROBORANE AND ALUMINUM BROMIDE-TRIBROMOBORANE, by R. L. Barnes and T. Wartik. [1960] 76p. incl. diagrs. tables, refs. (AFOSR-TN-60-543) (AF 49(638)86) AD 237150 Unclassified

The solubility of aluminum chloride in trichloroborane at 24°C was measured and found to be 0.0090 g aluminum chloride per 100 g trichloroborane. The solubility of aluminum bromide in tribromoborane at 25.3°C was measured and found to be 42.2 g aluminum bromide per 100 g tribromoborane. The lower of the 2 values quoted by Adamsky and Wheeler (Jour. Phys. Chem., v. 58: 225, 1954) at this temperature is 34% higher than the above. The solubility curve for aluminum bromide in tribromoborane was obtained over the temperature range -43.5°C to 81.3°C and compared with the phase diagram for the system reported in the literature. The solubilities of aluminum bromide in tribromoborane and of aluminum chloride in trichloroborane are lower than those predicted by ideal behavior. The deviations from ideality are discussed from the viewpoint of the internal pressure concept and the Hildebrand equation for regular solutions. The electrical ac conductivity measurements showed that electrolysis of solutions of aluminum chloride in trichloroborane and of aluminum bromide in tribromoborane (specific conductance of the solutions was, in both cases, less than 3×10^{-5} ohm^{-1} cm^{-1}) would not afford a practical method for the preparation of reduced boron halides. (Contractor's abstract)

2014

Pennsylvania State U. Dept. of Chemistry, University Park.

THE THERMAL DECOMPOSITION AND HYDROGENATION OF DIBORON TETRACHLORIDE AND DIBORON TETRAFLUORIDE, by J. B. Barr and T. Wartik. [1960] 197p. incl. diagrs. tables, refs. (AFOSR-TN-60-1025) (AF 49(638)86) AD 241941 Unclassified

Kinetic studies are carried out on the thermal decomposition and hydrogenation of diboron tetrachloride and diboron tetrafluoride. A possible mechanism for the decomposition into trichloroborane and nonvolatile solid subchlorides is derived from the kinetic

investigation carried out at temperatures between 138°C and 155°C. The data satisfy the rate expression for a heterogeneous reaction strongly retarded by its reaction products, and the graphical treatment and calculated rate constants indicate a second order reaction.

2015

Pennsylvania State U. Dept. of Chemistry, University Park.

CHEMISTRY OF BORON COMPOUNDS, by T. Wartik. Final rept. Oct. 1, 1956 - June 30, 1960. Nov. 1960, 10p. (AFOSR-TR-60-159) (AF 49(638)86) Unclassified

The investigations dealt with under this contract involved 3 different aspects of boron chemistry. The first was directed toward measurement of the thermal stabilities of diboron tetrahalides and a determination of the mode of their decomposition. The second dealt with the use of electric discharge methods for the preparation of new types of boron-containing materials. The third study involved a determination of some properties of solutions of aluminum trihalide in liquid boron trihalide. The results are reported in previous publications (PSU. 04:002, Vol. I; PSU. 10:001, Vol. II; and item nos. 2013 and 2014, Vol. IV. In addition three more papers are now being prepared for publication.

2016

Pennsylvania State U. Dept. of Chemistry, University Park.

CONDITIONS FOR STEREOSPECIFIC OLEFIN-MERCAPTAN RADICAL ADDITIONS, by P. S. Skell and R. G. Allen. Feb. 8, 1960, 3p. (AFOSR-TN-60-80) (AF 49(638)457) AD 232550; PB 145667 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 1511-1512, Mar. 20, 1960.

The reaction of CH_3SD with the cis- and trans-2-butenes at 70° produced a nonstereospecific addition. Under reaction conditions producing only minor amounts of olefin isomerization, the products were the same mixture of erythro- and threo-3-deuterio-2-methylthiobutane starting with either olefin. Rationalization of these observations requires an open-chain radical which isomerizes more rapidly than the transfer of a deuteron from CH_3SD. In the presence of DBr, the formation of the 3-deuterio-2-bromobutanes from CH_3SD additions was stereospecific. The 3-deuterio-2-methylthiobutanes were also produced by stereospecifically trans additions, cis- and trans-2-butenes yielding threo- and erythro-products, respectively. These results require that (1) DBr be the sole transfer agent with radicals such as CH_3-CHX-CH-CH_3 and (2) the equilibration Br- + CH_3SD ⇌ DBr + CH_3S- be more rapid than additions of Br- and CH_3S- to these olefins. Steric control of mercaptin addition is achieved by the rapid reaction of the diastereomerically related 3-methylthio-2-butyl radicals with HBr, a reaction which is more rapid than the isomerization of the radicals. (Contractor's abstract)

2017

Pennsylvania State U. Dept. of Chemistry, University Park.

RADICAL REARRANGEMENTS IN BROMOALKYL RADICALS, by P. S. Skell, R. G. Allen, and N. D. Gilmour. [1960] [2]p. incl. diagrs. (AFOSR-60) (AF 49(638)457) AD 250896 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 504-505, Jan. 1961.

Radical chain chlorination of isopropyl and propyl bromides and of isobutyl and t-butyl bromides demonstrated that 100% rearrangement results from the removal of a hydrogen atom from the methyl groups of isopropyl and t-butyl bromides. These rearrangements occur much more rapidly than the transfer of a chlorine atom to these radicals. Bromine atom migration is much faster than methyl migration.

2018

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

TRANSIENT THERMAL STRESSES IN A THIN DISK, by W. Jaunzemis. May 1961, 16p. (Technical rept. no. 1) (AFOSR-TN-60-1166) (AF 49(638)705) AD 259531 Unclassified

This investigation is concerned with the effects of inertia and thermodynamic coupling upon thermal stresses produced in a thin disk. Rotational symmetry is assumed, and the problem is treated within the 2-dimensional theory of elasticity. A solution is obtained in the form of an infinite series, and comparison is made with solutions in which effects of inertia or thermodynamic coupling are neglected. For the problem considered, the effects of inertia and thermodynamic coupling are found to be negligible. (Contractor's abstract)

2019

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

THERMAL STRESSES PRODUCED IN A DISK BY A ROTATING HEAT SOURCE, by G. T. Vavouras and W. Jaunzemis. May 1961, 23p. incl. diagrs. (Technical rept. no. 2) (AFOSR-TN-60-1167) (AF 49(638)705) AD 259532 Unclassified

A study was made of thermal stresses generated in a disk by a rotating heat source. The problem is treated within 2-dimensional elasticity theory, and inertia effects as well as thermodynamic coupling are neglected.

The solutions for the stresses and the temperature are obtained in the form of infinite series of elementary and Bessel functions. Relative to a coordinate system rotating together with the heat source, the solutions for the stresses and temperature separate into transient and non-transient parts, the decay of the transient solutions being relatively slow. Numerical results are presented, and the behavior of stresses and temperature is studied in some detail, particularly for points near the edge of the disk. (Contractor's abstract)

2020

Pennsylvania State U. [Dept. of Mathematics] University Park.

SUMMABILITY METHODS ON MATRIX SPACES, by J. Mitchell. [1960] [15]p. incl. refs. (AFOSR-3038) (AF 49(638)826) Unclassified

Presented at meetings of the Amer. Math. Soc., [New York] Jan. 29, 1960 and Jan. 24, 1961.

Also published in Canad. Jour. Math., v. 13: 63-77, 1961.

Four types of irreducible bounded symmetric domains of matrix spaces are considered. Let $z = (z_{jk})$ be a matrix of complex numbers, z' its transpose, z^* its conjugate transpose and $I = I^{(n)}$ the identity matrix of order n. Then the first 3 types are defined by $D = [z|I - zz^* > 0]$, where z is an n by m matrix ($n \leq m$), a symmetric or a skew-symmetric matrix of order n. The fourth type is the set of complex spheres satisfying $|z'z| < 1$, $1 - 2z^*z + |z'z|^2 > 0$, where z is an n by 1 matrix. The following problem for the first type of domain with m = n, in which case u is a unitary matrix, the (real) dimension of B is n^2 and of D is $2n^2$. Let f(u) be a real integrable function defined on B and consider the integral operator $I(f, z) = \int_B P(z, u)f(u)dV$, where $P(z, u)$ is the Poisson kernel, $P(z, u) = V^{-1}\det{}^n(I - zu^*)^{-1}(I - zz^*)(I - uz^*)^{-1}$, V is the Euclidean volume of B, and dV the Euclidean volume element. Some properties for the first type of domain ($n \leq m$) of complete orthonormal systems (CONS) is considered; application of the CONS $\{\psi_\nu\}$ are also given.

2021

Pennsylvania State U. [Field Emission Lab.] University Park.

THE STUDY OF METAL SURFACES BY THE FIELD ION MICROSCOPE, by E. W. Müller, W. T. Pimbley, and J. F. Mulson. [1958] [14]p. incl. illus. diagrs. [AF 18(600)672] Unclassified

Published in Internal Stresses and Fatigue in Metals: Proc. of the Symposium, Detroit and Warren, Mich. (Sept. 4-5, 1958), New York, Elsevier Publishing Co., 1959, p. 189-202.

The application of the field ion microscope and the experimental data that it provides is reviewed briefly with sample illustrations. This microscope has 2 special features. First, its resolution is of the order of 2A so that individual atoms of the crystal are rendered visible. Secondly, when the microscope is in operation, the field strength at the metal surface is of the order of 500 mv/cm. In the study of metals, interest has primarily been placed on faults of the metal crystal rather than its perfection. Another line of investigation that has been pursued is to study the effect of fatigue in metal crystals. Field ion microscope illustrations of these are presented.

2022

Pennsylvania State U. [Field Emission Lab.] University Park.

[OBSERVATIONS OF ATOMIC STRUCTURE OF A METAL SURFACE BY THE FIELD ION MICROSCOPE] Beobachtungen der atomaren Struktur von Metalloberflächen im Feldionenmikroskop, by E. W. Müller. [1959] [16]p. incl. illus. diagrs. refs. [AF 18(600)672] Unclassified

Published in Proc. Fourth Internat'l. Conf. on Electron Microscopy, Berlin (Germany), Sept. 10-17, 1958, Berlin, Springer-Verlag, v. 1: 820-835, 1960.

The working conditions of the helium operated low temperature field ion microscope are described. The resolution of atom chains of 2.74A spacing, and of a 2-dimensional net of 2.77A spacing is shown in photographs, while a visual observation of a net plane resolution of 2.35A is reported. Field evaporation at low temperatures produces perfectly clean and regularly built surfaces, which will not be contaminated during observation by even 1 atom, in spite of the use of a ground joint for easy sample replacement. The rate of field evaporation limits the application to about 8 elements for best image quality, and 1 other dozen of metals with limited image stability. Field evaporation of the refractory metals yields doubly charged ions. A number of high resolution photographs of wolfram, rhenium, iridium, platinum and nickel crystals are shown, exhibiting atomic details of stacking faults, dislocations, subgrain boundaries and slip bands. The effect of recovery of platinum and iridium crystals is demonstrated. Fatigue experiments are made with platinum crystals, exposing them during the observation in the microscope to a cycling stress of 1,000 kg/mm^2. Operation of the cycling stress at audio frequencies led to the discovery of resonance vibrations. These seem to be characteristic for the metal, and they may represent energy exchange frequencies between high frequency lattice vibration modes. (Contractor's abstract)

2023

Pennsylvania State U. Field Emission Lab., University Park.

FIELD IONIZATION AND FIELD ION MICROSCOPY, by E. W. Müller. [1960] [94]p. incl. illus. diagrs. tables, refs. (AFOSR-TN-60-113) (AF 49(638)504) Unclassified

Also published in Advances in Electron. and Electron Phys., v. 13: 83-179, 1960.

The merits of the technique of studying free atoms, metal surfaces experiencing field ionization or field ion emission, and field ion microscopy applications are discussed. The physical phenomenon being utilized is the tunnel effect of an atom's electrons in a high electric field. The advantage of increased resolution is provided by the high electric fields introduced by the needle-shaped, surface migration-polished field emitter and the invention of the field emission microscope. The microscope is capable of showing individual atoms as they form the crystal lattices of the tip metal with full resolution of the high index net planes and the separating atoms with spacings down to 2.3A. Some of the work on theory and experiment in basic studies in solid state physics and physical metallurgy is presented, including field ionization of free atoms, near a metal surface and field ion emission from a metal surface. Possible applications to mass spectroscopy and ionic propulsion systems are also mentioned.

2024

Pennsylvania State U. [Field Emission Lab.] University Park.

OBSERVATION OF RADIATION DAMAGE WITH THE FIELD ION MICROSCOPE. IV. METHODS OF INVESTIGATION, by E. W. Müller. [1960] [10]p. incl. illus. (AFOSR-3520) [AF 49(638)504] Unclassified

Also published in Reactivity of Solids; Proc. Fourth Internat'l. Symposium, Amsterdam (The Netherlands) (May 30 - June 4, 1960), Amsterdam, Elsevier, 1961, p. 682-691.

In the field ion microscope individual lattice vacancies can be seen and their density determined by controlled field evaporation and examination of each net plane appearing at the surface. Interstitials just below the surface as they are intrinsically present as imperfections, or as they are introduced by diffusion, appear clearly in the form of bright spots when they bulge out a surface net plane. The intersection with the surface of single dislocations or more complex imperfections are easily recognized in otherwise perfect metal crystals. The production of all those defects by irradiation can be observed instantaneously if the microscope is connected with a radiation source. While the specimen is kept at liquid hydrogen temperature, undesired annealing of point defects is prevented. Two experiments were conducted, one with a 1-mc 5.4 mev α-particle source and the other with well collimated 20 kev neutral helium atoms. The greatest damage to the lattice was caused by bombardment of the surface with ions of a few hundred ev energy in normal incidence.

At ion current densities of 10^{-2} A/cm^2 the initial perfection of the lattice is destroyed within a few sec, and complex dislocations appear. These can be rearranged, but not completely removed, by the stress connected with field evaporation. (Contractor's abstract, modified)

2025

Pennsylvania State U. [Field Emission Lab.] University Park.

MEASUREMENT OF THE WORK FUNCTION OF AN ATOMICALLY SMOOTH SINGLE CRYSTAL PLANE (Abstract), by R. D. Young and E. W. Müller. [1960] [1]p. (AF 49(638)504) Unclassified

Presented at annual meeting of Field Emission Symposium, McMinnville, Ore., Aug. 31 - Sept. 3, 1960.

In 1955 the work function of thermally smoothed single crystal planes was measured with the field electron microscope; since that time the development of field ion microscope techniques has enabled the formation and observation of atomically smooth, ideally perfect planes. By heating the microscope tip to approximately 600°C and applying a field of about 7×10^7 v/cm, the (110) and (112) planes can be sufficiently enlarged so that measurements can be confined to either of these planes without contribution from adjacent areas. Apparatus has been developed to combine the ion and electron emission techniques in order to obtain a value for the work function which can be compared with theoretical treatments.

2026

Pennsylvania State U. [Field Emission Lab.] University Park.

A METHOD FOR THE STUDY OF THE INTERACTION OF SLOW ELECTRONS WITH SURFACE ATOMS (Abstract), by R. D. Young. [1960] [1]p. (AF 49(638)504) Unclassified

Presented at annual meeting of Field Emission Symposium, McMinnville, Ore., Aug. 31 - Sept. 3, 1960.

The flux of slow electrons released in the field ionization process interacts with surface atoms in the field ion microscope so as to increase the rate of field evaporation from the surface. While a quantum mechanical treatment is necessary, in the first approximation this process can be described classically by the momentum exchange in a billiard ball collision between an incoming electron and a fixed surface atom. For example, a 10 ev electron can transfer at most .002 ev to a surface atom of a beryllium tip, an amount which is slightly higher than the kT energy associated with the liquid hydrogen temperature of the tip. Thus the electron supplies an additional activation to assist the surface atom over its potential hump (electron impact activated field evaporation). By adding a small amount of an inert gas of low ionization energy to the helium ion microscope, and by varying the tip radius, it is possible to cover an energy range of the incident electrons from a few ev to several thousand ev.

2027

Pennsylvania State U. Groth Inst., University Park.

A CRYSTALLOGRAPHIC LEAST-SQUARES REFINEMENT PROGRAM FOR THE IBM 704: IDENTIFICATION

PS XR3, by V. Vand and R. Pepinsky. Oct. 1, 1959, 1v. incl. diagr. tables. (Rept. no. 52) (AFOSR-TN-60-47) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)416, Atomic Energy Commission under AT(30-1)1516, National Institutes of Health under A-228, and Office of Naval Research under N6onr-26916) AD 418723 Unclassified

This program performs an iterative procedure which adjusts unknown parameters — which are in this case the atomic coordinates x_i, y_i, z_i of a given crystal structure and the isotropic temperature factor B_i of individual atoms — until the calculated structure factors F_{calc} show the best agreement with the observed structure factors F_{obs}. This is achieved by using the diagonal approximation of the least-squares method. Since the crystal structure equations are highly non-linear, only the first linear terms of the Taylor expansion are used, and the initial solution must be approximately known and supplied to the computer via the so-called coordinate deck read with the program.

2028

Pennsylvania State U. Groth Inst., University Park.

ROTATED TABULATION OF CHEMICAL NAMES: HEXAGONAL CRYSTALS, BARKER INDEX OF CRYSTALS, VOLUME I, PART II, by V. Vand and R. Pepinsky. Feb. 7, 1960, 52p. incl. tables. (Rept. no. 45) (AFOSR-TN-60-240) (AF 49(638)416) Unclassified

This report reproduces the rotated tabulation of chemical names from one section of the Barker Index Crystals. It is prepared to illustrate the appearance of a rotated tabulation only, and is in itself of no use for sort or retrieval purposes. It contains the same data as that presented in Report no. 44, Concordance of Chemical Names (2C) and List of Chemical Names on Continuation Cards (2E) (item no. 2029). Report no. 44 is thus a sort taken from the cards tabulated in the present report. (Contractor's abstract)

2029

Pennsylvania State U. Groth Inst., University Park.

CONCORDANCE OF CHEMICAL NAMES (REPORT NO. 2C) AND LIST OF CHEMICAL NAMES ON CONTINUATION CARDS (REPORT NO. 2E) OF HEXAGONAL CRYSTALS IN THE BARKER INDEX OF CRYSTALS VOLUME I, PART II, by V. Vand and R. Pepinsky. Feb. 6, 1960 [59]p. incl. tables ept. no. 44) (AFOSR-TN-60-241) (AF 49(638)4 Unclassified

A concordance report is presented for a portion of the Barker Index of Crystals as an example of information retrieval techniques being administered at the Groth Institute. In preparing the concordance, literature image cards are transcribed by an IBM Cardatype into proper machine language cards acceptable to an IBM 407 Tabulator. The machine language cards are processed on the Cardatype, producing a separate card for each word in a sentence (grouping of words), the sentence being rotated such that it begins with a different word on each card. The cards are then sorted alphabetically and tabulated on the 407 as a C-Report. For sentences too long to appear on one card, continuation cards are made up and rotated separately from the first part of the sentence. These are sorted and tabulated as an E-Report and attached to each C-Report. Though a Cardatype alone could perform the required tasks, the combination of it with the 407 proved to be a more efficient and successful system.

2030

Pennsylvania State U. Groth Inst., University Park.

ROTATION AND CONCORDANCE OF WORDS IN TITLES OF NINE PHYSICAL REVIEW ARTICLES, VOLUME 114, 1959, by R. Pepinsky, V. Vand, and T. Manganello. Feb. 15, 1960, 14p. incl. tables. (Rept. no. 46) (Request concordance rept. no. 1RC) (AFOSR-TN-60-242) (AF 49(638)416) Unclassified

This report comprises a possible format for a "permuted title index" to be used for journals of the American Institute of Physics. An image of 9 titles and authors, taken from v. 114 of Phys. Rev. is presented in the format of the Groth Institute, but without the usual inclusion of the year of publication. The titles are arranged alphabetically against the first word of the title, and an index of authors is included. Preparations and tabulations are done on an IBM Cardatype and an IBM 407. Titles are rotated with each word of the title appearing once at the start of the line; the purpose of this is to permit preparation of a concordance of important words in the titles. The process is entirely automatic, once the authors and titles have been extracted and punched onto cards.

2031

Pennsylvania State U. Groth Inst., University Park.

HIGHER LEVEL CONCORDANCE (REPORT NO. 2A) OF SPLIT WORDS OCCURRING IN CHEMICAL NAMES OF HEXAGONAL CRYSTALS IN THE BARKER INDEX OF CRYSTALS, VOLUME I, PART II, by V. Vand and R. Pepinsky. Feb. 15, 1960 [29]p. incl. tables. (Rept. no. 47) (AFOSR-TN-60-243) (AF 49(638)416) Unclassified

This report describes a Higher Level Concordance of split words occurring in chemical names for the Hexagonal Section of the Barker Index of Crystals. From a glossary of words taken from Report 2C, a split-word glossary is constructed by dividing words in the original glossary into subwords. The split-word glossary is then rotated, sorted alphabetically, and tabulated on the IBM 407, the same as in Report 2C. The A-Report thus constructed serves two purposes: it serves as a concordance of subwords and also as key report to locate relevant information in the C-Report.

2032

Pennsylvania State U. Groth Inst., University Park.

NEW METHODS FOR MEGA-ITEM INFORMATION RETRIEVAL USING SMALL-SCALE MACHINES, by R. Pepinsky and V. Vand. Feb. 15, 1960, 14p. (Rept. no. 48) (AFOSR-TN-60-244) (AF 49(636)416) Unclassified

The concept of multistage search in the field of information retrieval is considered. Multistage search refers to a technique by which small-scale IBM machines can be used to search files containing millions of items. The system represents an outgrowth of the Peek-a-Boo method. To each item in the files an item number is assigned. To each descriptor or property of an item is assigned one Peek-a-Boo card, in which all the item numbers having that property are represented by punched holes. As 500 punches are conveniently available in the Peek-a-Boo field of one IBM card, a system can be adopted to group the items in reports, each report not containing more than 500 items. To each report corresponds one set of Peek-a-Boo cards, one each for each available descriptor. At this point, a single stage search would be exhausting if the items numbered in the millions. For multistage searching, each report is treated as a single item, having for descriptors all descriptors occurring within it. A second-line report is then prepared, together with its set of Peek-a-Boo cards to search for the first-line reports which contain the required descriptors. When these are found they are searched again; but only those first-line reports are searched which contain the required information. The capacity of such a two-stage search system is $500^2 = 250,000$ items. In this manner, the system can be extended to three-stage and larger systems, enabling millions of items to be searched in the time it would take to search a few thousand items using a single-stage method.

2033

Pennsylvania State U. Groth Inst., University Park.

GROTH INSTITUTE SORT AND RETRIEVAL PROGRAMS SUITABLE FOR LARGE-SCALE MACHINES, by R. Pepinsky and V. Vand. Feb. 16, 1960, 16p. (Rept. no. 49) (AFOSR-TN-60-256) (AF 49(638)416) Unclassified

The Groth Inst. has developed a multistage search scheme which is applicable to small-scale information retrieval methods. In this report it is described how these techniques can be extended to large-scale magnetic tape equipment. Input cards for the literature image are prepared in publication language, transcribed onto magnetic tape, and translated into Sort language. The translated literature image is sorted onto other tapes in a hierarchial system. Several types of search procedure are possible, the most rapid involving the Peek-a-Boo method, originally developed for manual searching. As the Groth Institute program is further developed, the problem of the extensive amount of data to be processed will again present itself. Storage and availability techniques are discussed.

2034

Pennsylvania State U. Groth Inst., University Park.

NEED FOR LARGE-SCALE COMPUTING EQUIPMENT FOR INFORMATION RETRIEVAL IN THE GROTH INSTITUTE, by R. Pepinsky. Dec. 1, 1959 [52]p. incl. tables, refs. (Rept. no. 50) (AFOSR-TN-60-595) (AF 49(636)416) AD 279805 Unclassified

The Groth Inst. need for large-scale tape-controlled computing equipment is discussed for the program of information retrieval of crystalline solid data. At the time of this report, the Institute has over a million IBM punched cards in its storage system, and it is argued that it is necessary for future development to obtain the services of a tape-controlled computing system such as the IBM 701. The amount of solid state information in literature is so extensive that if incorporated into a printed collection of data, it would likely fill a thousand large volumes. It is thus necessary that a highly mechanized computer system be employed to compare, index, and tabulate this information.

2035

Pennsylvania State U. Groth Inst., University Park.

DISCUSSION OF THE GROTH INSTITUTE AS PREPARED FOR DOCUMENTATION RESEARCH PROJECT, AMERICAN INSTITUTE OF PHYSICS, by R. Pepinsky. Apr. 4, 1960 [16]p. incl. tables. (Rept. no. 53) (AFOSR-TN-60-596) (AF 49(636)416) AD 279790 Unclassified

The Groth Inst. at Pennsylvania State U. is engaged in collecting all available information on the chemistry and physics of crystalline solids. High-speed computing machine methods are used for data retrieval, processing, and tabulation, and new computer techniques are explored. In this report, the Institute is described and its methods of information retrieval are explained. It is noted that the machine methods used are facilitated in that crystal properties are particularly suited to such techniques.

2036

Pennsylvania State U. Groth Inst., University Park.

PROPERTY SORT (4S) OF THE ORTHORHOMBIC CRYSTALS, INDEX NUMBERS 500-999, IN THE BARKER INDEX OF CRYSTALS, VOLUME I, PART II, by V. Vand and R. Pepinsky. Jan. 10, 1960, 161p. incl. tables. (Rept. no. 54) (AFOSR-TN-60-597) (AF 49(636)416) Unclassified

Property Sort 4S is to be used in conjunction with Report no. 25, Literature image 4L of the Barker Index of Crystals, Vol. 1, Part II. The material covers Index Numbers 500-999 of the Orthorhombic Crystals. (Contractor's abstract)

2037

Pennsylvania State U. Groth Inst., University Park.

PROPERTY SORT (5S) OF ORTHORHOMBIC CRYSTALS, INDEX NUMBERS 1000-1499, IN THE BARKER INDEX OF CRYSTALS, VOLUME I, PART II, by V. Vand and R. Pepinsky. Feb. 1, 1960, 183p. incl. tables. (Rept. no. 55) (AFOSR-TN-60-598) (AF 49-(638)416) Unclassified

Property Sort 5S is to be used in conjunction with Report no. 26, Literature Image 5L of the Barker Index of Crystals, Vol. I, Part II. The material covers Index Numbers 1000-1499 of the Orthorhombic Crystals. (Contractor's abstract)

2038

Pennsylvania State U. Groth Inst., University Park.

LITERATURE IMAGE (8L) OF MONOCLINIC CRYSTALS, INDEX NUMBERS 1-499, IN THE BARKER INDEX OF CRYSTALS, Volume II, PART II, by V. Vand and R. Pepinsky. Feb. 15, 1960, 213p. incl. tables. (Rept. no. 56) (AFOSR-TN-60-599) (AF 49(638)416) Unclassified

This report comprised the literature image of the Monoclinic section of the Barker Index of Crystals, Vol. II, Part II. Monoclinic Index numbers 1M-449M are included. The data are presented in the form of a literature image on IBM cards, and the arrangement is the same as that used in the Barker Index.

2039

Pennsylvania State U. Groth Inst., University Park.

PROVISIONAL LITERATURE IMAGE (50L) OF DONNAY AND DONNAY, CRYSTAL DATA, PART II, NEW EDITION, TETRAGONAL CRYSTALS, SECTION 1, JULY 1960. July 10, 1960, 105p. incl. tables. (Rept. no. 60) (AFOSR-TN-60-969) (AF 49(638)416) Unclassified

This report consists of a temporary literature image of the first tetragonal section of the new edition of Crystal Data by J. D. H. Donnay and G. Donnay. It was automatically prepared and printed on small-scale IBM machines, from IBM cards. Reproduction is accomplished by standard photo-offset processing. There are serious errors within this report and Reports 51L and 52L, due to the fact that the extracting was accomplished in a great hurry to make the reports available for demonstration at the Cambridge Congress of the International Union of Crystallography in August of 1960. These errors are discussed in a subsequent report, (item no. 2043).

2040

Pennsylvania State U. Groth Inst., University Park.

PROVISIONAL LITERATURE IMAGE (51L) OF DONNAY AND DONNAY, CRYSTAL DATA, PART II, NEW EDITION, TETRAGONAL CRYSTALS, SECTION 2, JULY 1960. July 10, 1960, 104p. incl. tables. (Rept. no. 61) (AFOSR-TN-60-970) (AF 49(638)416) Unclassified

This report consists of the second tetragonal section of the new edition of Crystal Data as described in item no. 2039.

2041

Pennsylvania State U. Groth Inst., University Park.

PROVISIONAL LITERATURE IMAGE (52L) OF DONNAY AND DONNAY, CRYSTAL DATA, PART II, NEW EDITION, TETRAGONAL CRYSTALS, SECTION 3, JULY 1960. July 10, 1960, 65p. incl. tables. (Rept. no. 62) (AFOSR-TN-60-971) (AF 49(638)416) Unclassified

This is the third tetragonal section of Donnay and Donnay's Crystal Data as described in item nos. 2039 and 2040.

2042

Pennsylvania State U. Groth Inst., University Park.

TABULATION OF PART II, DETERMINATIVE TABLES, OF CRYSTAL DATA, TETRAGONAL CRYSTAL SYSTEM, SECTION 1, by J. D. H. Donnay and G. Donnay. July 21, 1960, 56p. incl. tables. (Rept. no. 63; request rept. no. 50R) (AFOSR-TN-60-972) (AF 49(638)416) Unclassified

This report consists of a rearrangement of Report 50L (item no. 2039), in a format suggested by Prof. Donnay and more suitable for final printing. Aside from proofreading and checking, the entire tabulation is automatically accomplished on punched card machines. The provisional sample preprints contain data extracted from Donnay and Donnay's Crystal Data.

2043

Pennsylvania State U. Groth Inst., University Park.

PROVISIONAL PROPERTY SORT (50S) CORRESPONDING TO LITERATURE IMAGE 50L, FROM DONNAY AND DONNAY, CRYSTAL DATA, PART II, NEW EDITION, TETRAGONAL CRYSTALS, SECTION 1, JULY 1960. July 26, 1960, 85p. incl. tables. (Rept. no. 64) (AFOSR-TN-60-973) (AF 49(638)416) Unclassified

This report is comprised of a Property Sort of information in Literature Image 50L. It was automatically prepared from the L-Report by simple machine methods described in (item no. 2048). As was mentioned in Literature Image 50L, the hurrying of the extraction of data in order to make the report available in time for a demonstration incurred several errors. These errors are further discussed here.

2044

Pennsylvania State U. Groth Inst., University Park.

SAMPLE FROM EXTRACTORS' MANUAL FOR THE GROTH INSTITUTE, SECOND REVISED EDITION, PART I: GENERAL DISCUSSIONS AND DIRECTIONS, by R. Pepinsky, M. Neuberger, and T. Manganello. July 27, 1960 [37]p. incl. tables. (Rept. no. 65) (AFOSR-TN-60-974) (AF 49(638)416) Unclassified

A portion of a new extractors' manual is presented. It is to be used in conjunction with Report no. 32 (item no. 1558, Vol. III). Some principles for extracting are given, and several sample extractors' forms are shown. Special problems related to the Groth Inst. are discussed.

2045

Pennsylvania State U. Groth Inst., University Park.

ON CRYSTALLOGRAPHIC DATA EXTRACTION AT THE SOURCE: A PROPOSAL TO THE INTERNATIONAL UNION OF CRYSTALLOGRAPHY, by R. Pepinsky. July 28, 1960, 30p. incl. tables, refs. (Rept. no. 66) (AFOSR-TN-60-975) (AF 49(638)416) Unclassified

A proposal is made to the International Union of Crystallography for its cooperation in a new data-retrieval procedure. The procedure involves the extraction of crystallographic data from ready-to-be-published papers onto satisfactory extraction forms by the primary authors before the papers are sent to print. This would be similar to the present requirement that all crystallographers submit an abstract with each publication. It is argued that this would keep the Groth Institute files more up-to-date by one to two years.

2046

Pennsylvania State U. Groth Inst., University Park.

NEW SYSTEM OF TABULATED REPORT PAGE IDENTIFICATION IN THE GROTH INSTITUTE, by R. Pepinsky. Aug. 2, 1960, 8p. incl. table. (Rept. no. 67) (AFOSR-TN-60-976) (AF 49(638)416) AD 279809 Unclassified

A new numbering system is described which is to be used by the Groth Inst. in page numbering. The identification on each page of material is broken down into 5 parts. The first part consists of the Groth Inst. symbol GI and the year of the report. The second symbol represents the collation of data. The third is the chronciogical numbering of sets within each collation. The fourth represents the type of report with an additional modifying descriptor, and the fifth is the page number. In this system, page 49 in the first set of entries of the Barker Index, which is a Literature Image and extracted in 1960, will be denoted GI60-BI.H/001/L/049.

2047

Pennsylvania State U. Groth Inst., University Park.

SAMPLE TABULATIONS (10R) OF ASTM POWDER DIFFRACTION CATALOGUE, by V. Vand and R. Pepinsky. Dec. 1, 1960 [9]p. incl. diagrs. tables. (Rept. no. 73) (AFOSR-183) (AF 49(638)416) Unclassified

Sample tabulations are presented for data from the American Society for Testing Materials Catalogue of X-Ray Powder Diffraction Data. The meanings of abbreviations are listed and reproductions of cards 10-503 and 10-504 are given, as provided to extractors for their work. Images of the data from these cards are then given, as tabulated from Cardatypes after extracting, checking, punching, and proofreading. The final page is a tabulation of the image from the catalogue summary, giving the spacing and relative intensities of the three strongest lines in each pattern according to chemical names, and with corresponding ASTM card numbers listed.

2048

Pennsylvania State U. Groth Inst., University Park.

PROPERTY SORT (7S) OF THE BARKER INDEX, ORTHORHOMBIC CRYSTALS 2000 - 0 TO 2156 - 0 (COMPLETED), by V. Vand and R. Pepinsky. Nov. 15, 1960, 51p. incl. tables. (Rept. no. 72) (AFOSR-184) (AF 49(638)416) Unclassified

Property Sort 7S is to be used in conjunction with Report no. 28, Literature Image 7L of the Barker Index of Crystals, Vol. I, Part II. The material covers Index Numbers 2000-2156 of the Orthorhombic Crystals. (Contractor's abstract)

2049

Pennsylvania State U. Groth Inst., University Park.

LITERATURE IMAGE (11L) OF THE BARKER INDEX, MONOCLINIC CRYSTALS 1500 M TO 1999 M, by V. Vand and R. Pepinsky. Oct. 15, 1960, 207p. incl. tables. (Rept. no. 70) (AFOSR-186) (AF 49(638)416) Unclassified

This report comprises the literature image of the fourth part of the Monoclinic section of the Barker Index of Crystals, Vol. II, Part II. Monoclinic Index numbers 1500M-1999M are included. The data are presented in the form of a literature image on IBM cards, and the arrangement is the same as that used in the Barker Index.

2050

Pennsylvania State U. Groth Inst., University Park.

LITERATURE IMAGE (9L) OF THE BARKER INDEX,

MONOCLINIC CRYSTALS 500 M TO 999 M, by V. Vand and R. Pepinsky. Sept. 15, 1960, 234p. incl. tables. (Rept. no. 68) (AFOSR-188) (AF 49(638)416) Unclassified

This report comprises the literature image of the second part of the Monoclinic section of the Barker Index of Crystals, Vol. II, Part II. Monoclinic Index numbers 500M-999M are included. The data are presented in the form of a literature image on IBM cards, and the arrangement is the same as that used in the Barker Index.

2051

Pennsylvania State U. Groth Inst., University Park.

CONCORDANCE OF CHEMICAL NAMES (2C), IN NEW STYLE, FOR HEXAGONAL CRYSTALS, INDEX NUMBERS 1-434, IN THE BARKER INDEX OF CRYSTALS, VOLUME I, PART II, by V. Vand, R. Malinoski, and R. Pepinsky. Apr. 15, 1960, 76p. incl. tables. (Rept. no. 57) (AFOSR-2329) (AF 49(638)416) Unclassified

In Report no. 44 (item no. 2029), an example of a concordance was presented as part of Groth Inst. project of information retrieval of crystalline solid data. This report presents an improved layout to that used in Report 44. Instead of directly tabulating the rotated cards, the cards are collated with the original unrotated cards. The rotated word is tabulated only once, as a heading, and unrotated cards follow. This has the advantage that the continuation cards are included. Thus, for example, under the heading of HYDRATE follow all compound names having the word HYDRATE anywhere, even on a continuation card.

2052

Pennsylvania State U. Groth Inst., University Park.

SAMPLE OF PREPRINT OF DONNAY'S CRYSTAL DATA, NEW EDITION, ed. by J. D. H. Donnay. June 10, 1960, 27p. incl. tables. (Rept. no. 58) (AFOSR-2330) (AF 49(638)416) Unclassified

This is a sample, in Literature Image form, of the revision by Prof. J. D. H. Donnay of his Crystal Data. The sample is taken from the new tetragonal section. It was automatically prepared and printed on small-scale IBM machines, from IBM cards. Reproduction is accomplished by standard photo-offset processing.

2053

Pennsylvania State U. Groth Inst., University Park.

EXAMPLES OF GROTH INSTITUTE DATA EXTRACTING FORMS AND PEEK-A-BOO CARDS. [1960] 22p. incl. diagrs. tables. (Rept. no. 59) (AFOSR-2331) (AF 49(638)416) Unclassified

Presented at Gordon Conf. on Information Processing for Critical Tables of Scientific Data, New Hampton, N. H., June 20-24, 1960.

A number of forms are presented which are to be used in conjunction with former Groth Institute reports to illustrate the following two steps in the information retrieval program of the Groth Inst.: (1) extraction of data from the literature to permit its transferance to IBM punched cards for later treatment; (2) use of automatically-prepared Peek-a-Boo cards for small-scale retrieval procedures. The initial transcription controls the Cardatype typewriters, which are presently used for critical tabulations. Fast tabulations for retrieval purposes are accomplished on a 407 Tabulator. Peek-a-Boo cards are found most useful for locating materials which display certain combinations of properties.

2054

Pennsylvania State U. Groth Inst., University Park.

NEW REPRESENTATION OF ABSORPTION CORRECTION FOR CYLINDRICAL AND SPHERICAL CRYSTALS (Abstract), by J. Van den Hende, M. Lovell and others. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)416 and Office of Naval Research under N6onr-26916) Unclassified

Published in Program and Abstracts, Amer. Cryst. Assoc., Washington, D. C., Jan. 24-27, 1960, Paper no. F-5.

For computer programming, a compact representation of a correction of observed intensity for absorption is important. Analysis of published tables shows that it is advantageous to expand the absorption correction into a Fourier series in Bragg angle θ, since three first items give sufficient accuracy. This Fourier series is, however, not as convenient to calculate as a power series in $\sin\theta$. The power series as such converges very slowly, or diverges; but by expanding just the three first terms of the Fourier series into powers, the same accuracy is obtained as if the Fourier series was used. The expansion has only three constants, which were calculated for various values of μr.

2055

Pennsylvania State U. Groth Inst., University Park.

METHOD OF LINEARIZATION OF FUNCTIONS FOR COMPUTER PROGRAMMING, AND ITS APPLICATION TO ATOMIC SCATTERING FACTORS (Abstract), by V. Vand and R. Pepinsky. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)416 and Office of Naval Research under N6onr-26916) Unclassified

Published in Program and Abstracts, Amer. Cryst. Assoc., Washington, D. C., Jan. 24-27, 1960, Paper no. F-8.

In evaluating functions on a computer, it is often of advantage to transform a computed function $f(x)$ into

$g(x) = b[f(x)]$ in such a way that $g(x)$ is nearly linear, so that a linear interpolation of its table with only a few entries gives sufficient accuracy, and the inverse of $h(f)$ is easy to evaluate; this provides a saving of time and space. This method has been applied with success to atomic scattering factors f. When $g(x) = 1/\sqrt{f(x)}$ is plotted against $x = \sin\theta/\lambda$, the plot is nearly linear, so that a table with only 8 entries interpolates with required accuracy. The scattering factor is then obtained as $f = 1/g^2$. This represents a fast and compact method, since the tables occupy only 8 storages per atom and are easy to prepare and replace.

2056

Pennsylvania State U. Groth Inst., University Park.

CRYSTALLOGRAPHIC INFORMATION RETRIEVAL METHODS IN THE GROTH INSTITUTE (Abstract), by R. Pepinsky and V. Vand. [1960] [1]p. (AF 49(638)-416) Unclassified

Published in Abstracts of Commun., Fifth Internat'l. Cong. and Symposia, Internat'l. Union Cryst., Cambridge (Gt. Brit.), Aug. 15-24, 1960, p. 123-124.

In the Groth Inst., all data on the physical and chemical properties of crystalline solids are being extracted from the literature and transferred to IBM punched cards. Information is coded in Publication language, with upper and lower case control symbols for Cards-type printouts, and in Sort language, which is upper case only for printouts by fast tabulators. Several types of reports are prepared, all but 2 of which are machine preparable using simple programs. Information retrieval methods are divisible into two classes: those using small-scale punched-card and paper-type machines and those using large-scale processing machines with magnetic tape and core storage. Coding of input data on punched cards is designed for processing by either class of processing equipment. Advances have been made in the applicability of small-scale machines for preparations of concordances and indices and for retrieval of data in mega-item card files. Files concordances, and indices are kept up-to-date automatically.

2057

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

CRYSTAL STRUCTURE OF FERROELECTRIC $LiH_3(SeO_3)_2$, by K. Vedam, Y. Okaya, and R. Pepinsky. [1960] [4]p. incl. illus. diagrs. refs. (AFOSR-TN-60-146) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35 and Atomic Energy Commission) Unclassified

Also published in Phys. Rev., v. 119: 1252-1255, Aug. 15, 1960.

The structure of the room-temperature ferroelectric $LiH_3(SeO_3)_2$ has been determined by x-rays, using the heavy-atom method, and refined on the IBM 704. The crystals are monoclinic, with space group Pn and $a = 6.25_8$ A, $b = 7.88_6$ A, $c = 5.43_3$ A, $\beta = 105.2°$. Fairly strong O—H···O bonds with distances 2.52, 2.56, and 2.57 A are found, nearly perpendicular to the polar direction. The O—Se—O angles in one of the two selenite ions are rather similar; in the other ion these angles are unequal, as in the structure of H_2SeO_3. Possible positions for the Li ions are given based on crystal-chemical considerations. (Contractor's abstract)

2058

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

FERROELECTRIC TRANSITION IN RUBIDIUM BISULFATE, by R. Pepinsky and K. Vedam. [1960] [2]p. incl. diagrs. (AFOSR-TN-60-147) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)35] and Atomic Energy Commission) Unclassified

Also published in Phys. Rev., v. 117: 1502-1503, Mar. 15, 1960.

$RbHSO_4$ is ferroelectric below -15°C. The room-temperature phase is monoclinic, with space group $P2_1/c$, $a = 14.35_6$A, $b = 4.62_2$A, $c = 14.80_7$A, $\beta = 121.0°$ and $Z = 8$. The symmetry of the ferroelectric phase is Pc, as established by systematic x-ray absences and the fact that spontaneous polarization appears along the c axis below -15°C. Both the high- and low-temperature phases are pseudo-orthorhombic. The dielectric constant ϵ_c at 10 kc/sec and for a field of 5 v/cm is 10 at room temperature; as the temperature is lowered, ϵ_c rises to a sharp peak of ~ 240 at -15°C and falls to ~ 5 at -196°C. The transition appears to be of second order. No second transition, as in the case of isomorphous NH_4HSO_4, could be detected in the temperature range -15°C to -196°C. (Contractor's abstract)

2059

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

SOME NEW X-RAY AND NEUTRON STUDIES OF HYDROGEN BONDING, by R. Pepinsky. [1957] [3]p. incl. refs. (AFOSR-TN-60-148) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35, Atomic Energy Commission, and Signal Corps) Unclassified

Also published in Symposium on Hydrogen Bonding, Internat'l. Union of Pure and Appl. Chem. and Union of Chem. Soc. of Yugoslavia, Ljublyana (Yugoslavia), (July 29 - Aug. 2, 1957), New York, Pergamon Press, 1959, p. 33-35.

Also published in Rev. Modern Phys., v. 30: 100, Jan. 1958.

For abstract see PSU. 08:019, Vol. II.

2060

Pennsylvania State U. [X-Ray and Crystal Analysis] Lab., University Park

CRYSTAL STRUCTURE OF THE FERROELECTRIC PHASE OF $(GLYCINE)_3 \cdot H_2SO_4$, by S. Hoshino, Y. Okaya, and R. Pepinsky. [1959] [8]p. incl. illus. diagrs. tables, refs. (AFOSR-TN-60-149) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)35], Atomic Energy Commission, Brookhaven National Lab., Office of Naval Research, and Signal Corps)] Unclassified

Presented at meeting of the Internat'l. Cryst. Convention, Leningrad (U.S.S.R.), May 21-27, 1959.

Presented at meeting of the Amer. Cryst. Assoc., Cornell U., Ithaca, N. Y., July 19-24, 1959.

Also published in Phys. Rev., v. 115: 323-330, July 15, 1959.

Ferroelectric $(glycine)_3 \cdot H_2SO_4$ crystallizes at room temperature in the monoclinic system with $\underline{a} = 9.41_7$ A, $\underline{b} = 12.64_3$ A, $\underline{c} = 5.73_5$ A, $\beta = 110°23'$; the space group is $P2_1$, and the polar direction is along the 2-fold screw axis. Above 47°C the spontaneous polarization disappears as the space group becomes $P2_1/m$.

The crystal structure was determined from full 3-dimensional x-ray diffraction data, using CuKα radiation. Out of the 3 glycine molecules in the crystal, 1 has the usual zwitter-ion configuration, with the NH_3^+ group out of the plane of the other atoms; the remaining 2 glycines are mono-protonated, and planar within experimental error, and are designated as glycinium ions. Thus the chemical formula is properly written as $(NH_3^+CH_2COO^-) \cdot (NH_3^+CH_2COOH)_2 \cdot SO_4^{--}$, and the compound is best described by the chemical name glycine diglycinium sulfate. One of the planar glycinium ions lies near but not in the plane $\underline{y} = 1/4$, which becomes the mirror plane in the high-temperature phase. There is disorder in this arrangement, even below the Curie point and down to a temperature of -70°C. The nitrogen atoms form N-H$\cdots$O hydrogen bonds of the usual strength, whereas a quite strong O-H$\cdots$O hydrogen bond with a distance of 2.43_8 A is found between the oxygen atom of the carboxyl group of the zwitter-ion glycine and that of the planar glycinium ion which lies near the plane $\underline{y} = 1/2$. Above the Curie point, at 47°C, mirror symmetry is attained by full statistical arrangement of molecules around the mirror plane at $\underline{y} = 1/4$ and 3/4. (Contractor's abstract)

2061

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

SOME NEW DIELECTRIC AND CONDUCTIVITY ANOMALIES IN CRYSTALS (Abstract), by R. Pepinsky, K. Vedam and others. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35 and Atomic Energy Commission under AT(30-1)1516) Unclassified

Published in Program and Abstracts, Amer. Cryst. Assoc., Washington, D. C., Jan. 24-27, 1960, Paper no. A-2.

New dielectric anomalies have been found in a large number of crystals. These include: $Ba(propionate)_2 \cdot H_2O$; $(C_2H_5NH_3)_2HgCl_4$ and related alkyl ammonium salts; a series of substituted amine mercuric iodides $[(R_1, R_2, R_3, phenyl)N]HgI_3$, where R_1 = methyl, ethyl, phenyl; $(NH_4)_2ZrF_6$, which is either ferroelectric or antiferroelectric below liquid nitrogen temperature; $MnSiF_6$; pyromorphite, which shows a large maximum near -100°C; and others. Remarkable conductivity anomalies, in the neighborhood of -60° to -90°C, have been discovered in a number of Tutton salts grown from acidic solution. Associated with these are dielectric anomalies, which can be discerned at higher frequencies. A similar type of anomaly has been found in $(thiourea)_2 \cdot HBr$. Fluctuations in the effects suggest that they may have their origins in imperfections in the crystals.

2062

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

THREE-DIMENSIONAL X-RAY EXAMINATION OF THE THREE PHASES OF ROCHELLE SALT (Abstract), by I. Krstanovic, Y. Okaya, and R. Pepinsky. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35 and Atomic Energy Commission under AT(30-1)1516) Unclassified

Published in Program and Abstracts, Amer. Cryst. Assoc., Washington, D. C., Jan. 24-27, 1960, Paper no. A-3.

A full 3-dimensional structural study on the 3 phases of Rochelle salt was initiated in order to obtain a basis for the better understanding of this important ferroelectric. Three-dimensional data were collected, using Cu-Kα radiation, at 32°C, at 20°C (for a deuterated crystal with a field applied parallel to the polar axis), and at -50°C, for the higher para-, ferro-, and low-paraelectric phases, respectively. Refinement of the non-hydrogen coordinates was carried out in the orthorhombic space group $P2_12_12$ since no deviation from this symmetry can be discerned in the x-ray case. Neutron measurements clearly show the ferroelectric phase to be in $P2_1$. The structures of the high para- and the ferroelectric phases have been refined using the NY XR3 program on the IBM 704. The starting coordinates were those of Mazzi et al for the x and y coordinates and of Beevers and Hughes for the z coordinates. The final R factors are .152 and .142 for the high para- and the ferroelectric phase, respectively. The structure of the low paraelectric phase is now being refined. It is interesting that there are no particularly significant differences in the hydrogen bond distances in the 2 upper

phases, although their values differ considerably from the previous data, frequently by more than .1A. The short O_1-O_{10} hydrogen bond is 2.69A (both phases) as compared to the reported value of 2.57A. Between the 2 phases, the O_9-O_{10}, O_6-O_{10}, and O_3-O_8, and several K-O distances, show differences of .04A (significant in terms of the standard deviations of these bonds).

2063

Pennsylvania State U. X-Ray Crystal Analysis Lab., University Park.

CRITICAL X-RAY SCATTERING AND THE PHASE TRANSITION IN $(GLYCINE)_3 \cdot H_2SO_4$ (Abstract), by I. Shibuya, T. Mitsui and others. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35 and Atomic Energy Commission under AT(30-1)1516) Unclassified

Published in Program and Abstracts, Amer. Cryst. Assoc., Washington, D. C., Jan. 24-27, 1960, Paper no. A-4.

Critical scattering of x-rays associated with the ferroelectric phase transition in $(glycine)_3 \cdot H_2SO_4$ has been studied both theoretically and experimentally. The transition is assumed to be of the order-disorder type and the actual crystal to be a statistical mixture of two basic structures for which the x-ray structure factors are $F_+ = A - iB$ and $F_- = A + iB$, respectively, with proper choice of the origin of coordinates. The long-range-order parameter S and a pair correlation function are defined in a manner analogous to that followed in the alloy case. Values of S are determined as a function of temperature by measuring the spontaneous polarization; the structure factor F of the actual crystal is given by $F = A - iSB$, and the intensity of the critical scattering is expressed by B^2 times a periodic function in reciprocal space. A method for evaluating the pair correlation function is proposed. The temperature dependence of the critical scattering is discussed on the basis of the Bragg-Williams approximation and of a modified Fröhlich theory. The critical scattering at a reciprocal lattice point has been found to be proportional to the dielectric constant. Experimental observations agree with the theoretical predictions, and prove that the phase transition in $(glycine)_3 \cdot H_2SO_4$ is of the order-disorder type. The observed critical scattering exhibits a pronounced peak at the Curie point, suggesting that the local field theory is not a good approximation. The shape of the curve appears to be quite different from that in the ferromagnetic case, and is helpful in explaining differences between the interaction forces of ferromagnetic dipoles and those of ferroelectric dipoles.

2064

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

ORDER-DISORDER TRANSITIONS IN NOVEL CAGE CHLOROCARBONS (Abstract), by Y. Okaya, R. Pepinsky, and E. E. Gilbert. [1960] [1]p. incl. diagr. table. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35 and National Institutes of Health under A-228) Unclassified

Published in Program and Abstracts, Amer. Cryst. Assoc., Washington, D. C., Jan. 24-27, 1960, Paper no. C-1.

Halocarbons of a novel cage structure have been studied thermally, dielectrically and by x-ray diffraction. The substances were $C_{10}Cl_{12}$, and symmetric and unsymmetric $C_{10}Cl_{10}Br_2$. Two transitions were observed in each compound. No dielectric anomalies in crystalline $C_{10}Cl_{12}$ were observed at either transition point. The dipole moment of the molecule, measured in benzene solution, was also found to be zero. These results support the centrosymmetric cage structure. Below their lower transition points all three crystals are orthorhombic with space group Abma or Ab2a. In this phase the molecules are not disordered. Above the lower transition point the crystals become cubic, with space group $P2_1/a3$, the molecules adopting a statistical arrangement around the body diagonal in such a manner as to satisfy the three-fold symmetry. Above the upper transition point, the space group changes to $F\frac{4}{m}\bar{3}\frac{2}{m}$; complete statistical orientation of the molecule is expected in this space group. Disordering can be suppressed by substituting some atomic group for the halogens at some point in the structure. This is done for $C_{10}C_{12}$ by replacing one Cl at a vertex (1) or (2) by a chlorosulfonate group. A structure analysis of the latter compound is in progress.

2065

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

CRYPTOSYMMETRY: A GENERALIZATION OF THE POINT-SYMMETRY CONCEPT (Abstract), by A. Niggli and H. Wondratschek. [1960] [1]p. [AF 18(603)35] Unclassified

Published in Program and Abstracts, Amer. Cryst. Assoc., Washington, D. C., Jan. 24-27, 1960, Paper no. D-7.

Generalized point-symmetries, so-called cryptosymmetries, may be obtained by attributing characteristic properties to the equivalent points of a point-symmetry, in such a way that the operations altering the properties form a group isomorphic to a factor group of the underlying point symmetry group. The residual symmetry of the points having the same property is described by the corresponding invariant subgroup, acting as kernel of the homomorphism. A cryptosymmetry operator may be expressed by attaching the matrix of a property-altering operation to the matrix of the point symmetry operation with which it is coupled. By attribution of one characteristic only, just as many cryptosymmetries are obtained as there

are irreducible representations of the symmetry group; similarly, the multiple cryptosymmetries obtained by attribution of several characteristics correspond to reducible group representations. The well-known antisymmetries and colored symmetries are special cases of simple cryptosymmetries for cyclic factor groups of order 2 and > 2, respectively, and their matrices of property-alteration are of degree one. Degenerate group representations correspond to more complex cryptosymmetries, using characteristics in several dimensions. The cryptosymmetry concept may be extended to space groups.

2066

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

THE OPTIMAL SHIFT METHOD FOR REFINEMENT OF CRYSTAL STRUCTURES (Abstract), by A. Niggli, V. Vand, and R. Pepinsky. [1960] 2p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)35], Atomic Energy Commission, Office of Naval Research, and Signal Corps) Unclassified

Presented at meeting of the Internat'l. Union of Crystallography, Fifth Congress, Cambridge (Gt. Brit.), Aug. 15-20, 1960.

The optimal shift method was devised in order that computers take over the task of shifting atoms to obtain agreement between a few $|F_c|$ and $|F_o|$ values formerly acquired by the trial and error method. In the case of centro-symmetry, the analytical expression for optical shifts perpendicular to the planes $\underline{H}$ is $\Delta x_j = \sum_{\underline{H}} \left\{ \Delta F_{\underline{H}} (\partial F_{\underline{H}} / \partial x_j) / \sum_i (\partial F_{\underline{H}} / \partial x_i)^2 \right\}_j$. Tests have shown that the optimal shift method converges much faster than other refinement methods, if the number of structure factors included is smaller than the number of parameters.

2067

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

THE USE OF A MONTE CARLO METHOD FOR OBTAINING TRIAL AND ERROR STRUCTURES (Abstract), by V. Vand, A. Niggli, and R. Pepinsky. [1960] 2p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)35], Atomic Energy Commission, Office of Naval Research, and Signal Corps) Unclassified

Presented at meeting of the Internat'l. Union of Crystallography, Fifth Congress, Cambridge (Gt. Brit.), Aug. 15-20, 1960.

An IBM 704 program has been written in which the absolute values of a limited set of structure factors serve as an input. A convenient set is 64 strongest structure factors. The program then internally emits random sets of coordinates of a predetermined number of atoms, and refines these in a small number of cycles, using a method of optimum shift. This method operates on 1 structure factor at a time, and shifts atoms according to the derivative of the structure factor. The method is not identical with that of least-squares, and has the advantage of being faster for refinement of a small number of reflections. The program then considers the disagreement factor of a structure so obtained. If this is lower than a certain limit, the coordinates and calculated structure factors are written down via magnetic tape. The limit itself is automatically movable, so that, in the long run, a predetermined number of trial structures is printed out. The most promising of these can serve as a starting point for further refinement by least-square methods.

2068

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

X-RAY AND NEUTRON ANALYSES OF FERROELECTRIC AND PIEZOELECTRIC-FERROMAGNETIC CRYSTALS (Abstract), by Y. Okaya, R. Pepinsky and others. [1960] 3p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)35], Atomic Energy Commission, Brookhaven National Laboratory, and Office of Naval Research) Unclassified

Presented at meeting of the Internat'l. Union of Crystallography, Fifth Congress, Cambridge (Gt. Brit.), Aug. 15-20, 1960.

The structure of the 3 phases of Rochelle salt were accurately determined in 3 dimensions from x-ray data. No anisotropy of K-ion vibrations appears in any phase, nor are these ions displaced from their special positions. The tartrate ion alters in configuration in the ferroelectric phase, due to a transfer of charge ($\sim 1/4\ \epsilon$) from 1 carboxyl to the other in the same ion. The infamous O_1-W_{10} H-bond plays no apparent role in the polarization. All H-coordinates in $(glycine)_3 \cdot H_2SO_4$ were established from b- and c-axis projections, using neutron data. Experimental and theoretical results of critical x-ray scattering and thermal measurements near the Curie point establish that the transition is of order-disorder type. Structural features based on extensive x-ray and neutron studies of the various phases of $(NH_4)_2SO_4$ and $(NH_4)_2BeF_4$ are reported, and polarization mechanisms explained in terms of these. Complete x-ray analyses of ferroelectric phases of $LiH_3(SeO_3)_2$ and $NaH_3(SeO_3)_2$ are described, as are x-ray studies of $RbHSO_4$, $Li(N_2H_5)SO_4$, $(glycine)_2 \cdot MnCl_2 \cdot 2H_2O$, and $(glycine)_2 \cdot HNO_3$. The structure of $GaFeO_3$, a piezoelectric-ferromagnetic, was determined with MoKα radiation. The structure is a new type, composed of highly distorted AO_3 and BO_3 octahedra and ABO_3 cubes.

2069

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

X-RAY STUDIES OF ABSOLUTE CONFIGURATIONS OF FERROELECTRIC CRYSTALS (Abstract), by R. Pepinsky, Y. Okaya, and F. Unterleitner. [1960] 4p. (AF 18(603)35) Unclassified

Presented at meeting of the Internat'l. Union of Crystallography, Fifth Congress, Cambridge (Gt. Brit.). Aug. 15-20, 1960.

The application of x-ray studies to the 2 classes of ferroelectrics, those with centrosymmetric pseudo-symmetry is discussed. The former class is made up of compounds such as $(glycine)_3 \cdot H_2SO_4$ (TGS), the perovskites, the alums, $(glycine)_2 \cdot HNO_3$, $glycine \cdot AgNO_3$, NH_4HSO_4, and probably also $(NH_4)_2SO_4$ and lithium hydrazinium sulfate. The tartrates (Rochelle salt, LiH tartrate$\cdot H_2O$), guanidinium aluminum sulfate hexahydrate, KH_2PO_4 (KDP), ammonium monochloracetate, di-calcium strontium hexapropionate, $(glycine)_2 \cdot MnCl_2 \cdot H_2O$, are constituents of class two. In class one, x-ray anomalous dispersion observations are necessary to establish the directions as well as magnitudes of small atomic displacements with respect to the electric field; in class two, the absolute configuration of the pseudo-symmetric non-centric phases must be established, then the magnitudes of small displacements in the ferroelectric phase determined, and finally the directions of these ascertained with respect to the field direction. Anomalous dispersion measurements of $|F_h|^2 - |F_{-h}|^2 = \Delta F_h^2$ values, for determination of the small atomic displacements in crystals of either class, can be made extremely accurate on a counter diffractometer, since field reversal alters h to -h values along the ferroelectric axis essentially without disturbing angular positions of the reflections.

2070

Pennsylvania State U. [X-Ray and Crystal Analysis Lab.] University Park.

A NEUTRON DIFFRACTION STUDY OF ORTHORHOMBIC PbO, by M. I. Kay. [1959] [2]p. incl. diagr. tables. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)35 and Atomic Energy Commission) Unclassified

Publisned in Acta Cryst., v. 14: 80-81, Jan. 10, 1961.

Tests of a neutron powder diffraction pattern of orthorhombic PbO are presented which provides information that couldn't be obtained from x-ray data. The results, presented in both graphic and tabular form, show that the Pb-O-Pb layers are more or less retained (stacked in the z direction) in the yellow phase. The oxygen layers, however, pucker to give distorted PbO_4 pyramids. The oxygens are surrounded by an exceedingly distorted tetrahedron of leads. The various bond distances are given and compared with tetragonal structure.

2071

Pennsylvania U., Philadelphia.

PROCEEDINGS OF THE CONFERENCE ON PHYSICAL CHEMISTRY IN AERODYNAMICS AND SPACE FLIGHT, PENNSYLVANIA U., PHILADELPHIA, SEPT. 1-3, 1959, ed. by A. L. Myerson and A. C. Harrison. New York, Pergamon Press, 1961 [280]p. incl. illus. diagrs. tables, refs. (AFOSR-TR-60-106) (Sponsored jointly by Air Force Office of Scientific Research and General Electric Co., Missile and Space Vehicle Dept.) Unclassified

Also published in Planetary and Space Sci., v. 3: 3-382, Feb. 1961.

Various physical chemical aspects of hypersonic aerodynamics and space flight have been reported. Topics covered include (1) Boltzmann equation for flows, (2) non-catalytic surface for dissociated combustion gases, and (3) periodic pressure variations.

2072

Pennsylvania U. [Dept. of Mathematics] Philadelphia.

A SEMIGROUP ASSOCIATED WITH A TRANSFORMATION GROUP, by R. Ellis. [1959] [10]p. (AFOSR-3829) (AF 18(600)1116) Unclassified

Also published in Trans. Amer. Math. Soc., v. 94: 272-281, Feb. 1960.

(X, T, π) is taken to be a transformation group with compact Hausdorff phase space X and $G = [\pi^t / t \in T]$ is the transition group of (X, T, π). G is a group of homeomorphisms of X onto X and so may be regarded as a subset of X^X. The enveloping semigroup E of (X, T, π) is defined as the closure of G in X^X. The algebraic properties of E are studied and correlated with recursive properties of T. The main theorem states that proximal is an equivalence relation in X if and only if there is only one minimal right ideal in E. Homomorphic images of transformation groups are studied by means of the enveloping semigroups.

2073

Pennsylvania U. [Dept. of Mathematics] Philadelphia.

AN EXTREMUM PROBLEM FOR POLYNOMIALS, by I. J. Schoenberg and G. Szego. [1959] [9]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)1158] and National Science Foundation) Unclassified

Published in Compositio Math., v. 14: 260-268, 1960.

The interval [a,b] is taken to be a finite interval and the measure $d_x(x)$ defines a positive mass-distribution which does not reduce to a finite number of point-masses. The natural integer n being given, π_n denotes the class of polynomials f(x) of degree not exceeding n and subject to the following two conditions: $f(x) \geq 0$ in [a,b], $\int_a^b f(x)d_x(x) = 1$. The range R_z of variability of f(z) for z an arbitrary but fixed real number is sought for the polynomial f(x) goes through the class π_n. As π_n is a convex class, it is clear that R_z is convex and, also, a bounded and closed interval. An analysis is given which reproduces the interval $R_z = [\min_{f\in\pi_n} f(z), \max_{f\in\pi_n} f(z)]$.

2074

Pennsylvania U. [Dept. of Mathematics] Philadelphia.

EXTENSION OF CONTINUOUS FUNCTIONS IN βN, by N. J. Fine and L. Gillman. [1960] [6]p. (AFOSR-3838) (AF 18(603)65) Unclassified

Also published in Bull. Amer. Math. Soc., v. 66: 376-381, Sept. 1960.

An investigation is made of conditions, in terms of zero sets, for every bounded (continuous, real-valued) function on a subset S of a space X to be extensible to S ∪ (p), or to X, or for S to be an "F-space". For example it is shown that the union of $\aleph_1$ cozero sets in an F-space is an F-space. Assuming the continuum hypothesis, a general theorem is obtained which includes the following special case. Given $p \in \beta N\text{-}N$ (βN denoting the Čech compactification of the discrete space of integers) there always exist a bounded continuous function on $\beta N\text{-}N$. By contrast, if $p \in \beta D\text{-}D$, where D is an uncountable discrete space, it is shown that the answer to the corresponding question, about extending all bounded continuous functions on $\beta D\text{-}D\text{-}(p)$ to $\beta D\text{-}D$, depends on p. (Math. Rev. abstract)

2075

Pennsylvania U. [Dept. of Mathematics] Philadelphia.

THE PROBABILITY THAT A MATRIX BE NILPOTENT, by N. J. Fine and I. N. Herstein. [1957] [6]p. (AFOSR-3839) [AF 18(603)65] AD 429099 Unclassified

Also published in Illinois Jour. Math., v. 2: 499-504, Dec. 1958.

A determination is made of the number of nilpotent n by n matrices over (1) a finite field of characteristic p, and (2) the integers modulo m. The results are most simple when expressed as probabilities by dividing by the total number of matrices in each case.

2076

Pennsylvania U. [Dept. of Mathematics] Philadelphia.

PAIRS OF COMMUTING MATRICES OVER A FINITE FIELD, by W. Feit and N. J. Fine. [1959] [4]p. (AFOSR-3840) [AF 18(603)65] Unclassified

Also published in Duke Math. Jour., v. 27: 91-94, 1960.

Let P(n) = P(n,q) denote the number of ordered pairs of (not necessarily distinct) commuting n by n matrices with elements in the finite field GF(q). It is proved that

$$P(n) = q^{n^2} f(n) \sum_{\pi(n)} \frac{q^{k(\pi)}}{f(b_1) f(b_2)\cdots f(b_n)}, \text{ where}$$

$f(n) = (1-q^{-1})(1-q^{-2})\cdots(1-q^{-n})$, $f(0) = 1$; the summation is over all partitions $n = b_1 + 2b_2 + \cdots$; and $k(\pi) = b_1 + b_2 + \cdots$. Also it is proved that $\sum_{n=0}^{\infty} \frac{P(n)}{q^{n^2} f(n)}$

$$x^n = \prod_{i=1}^{\infty} \prod_{j=0}^{\infty} (1-q^{1-j}x^i)^{-1}.$$ (Math. Rev. abstract)

2077

Pennsylvania U. [Dept. of Mathematics] Philadelphia.

UNIFORMIZATION OF LINEAR ARRAYS, by N. J. Fine and R. Harrop. [1957] [11]p. (AFOSR-5200) [AF 18(603)65] AD 428770 Unclassified

Also published in Jour. Symbolic Logic, v. 22: 130-140, June 1957.

The main result of the present paper is the existence of an effective method for embedding a weakly mapped array consistently in a uniform array. This carries with it the result that it is possible to obtain effectively a minimal uniform extension of the original array, that is, a uniform extension with minimum span for such an extension and with the minimum number of elements possible for a uniform extension with this span.

2078

Pennsylvania U. [Dept. of Mathematics] Philadelphia.

REGIONALLY ALMOST PERIODIC TRANSFORMATION GROUPS, by L. Bidwell. [1960] 42p. (AFOSR-TN-60-569) (AF 49(638)569) AD 242695 Unclassified

Theorems and lemmas are given with associated proofs. The expression "almost periodic" is used to describe C-recursive properties when C is the class of all left syndetic subsets of T. For instance, (X, T) is said to be regionally almost periodic at a point $x \in X$ provided that for each neighborhood U of x there exists a left syndetic subset C of T such that $U \subset \bigcap_{t\in C} tU \neq \Phi$ for each $t \in C$.

2079

[Pennsylvania U. Dept. of Metallurgical Engineering, Philadelphia]

ON THE ORIGIN OF DEFORMATION BANDS, by D. [Kuhlmann]-Wilsdorf and R. Guyard. [1960] [44]p. incl. illus. diagrs. (AFOSR-TN-60-100) (AF 49(638)-435) AD 292976 Unclassified

The aim of the present work was to develop techniques requisite for the study of the relation between accidental bendings and the nucleation of deformation bands, as well as to apply these techniques by producing and straining wavy crystals of aluminum, thereby introducing bending stresses while pulling. The experiments proved to be inconclusive. It was demonstrated, however, that the appearance of deformation bands was largely suppressed in the curved crystals used, leading to the conclusion that deformation bands are strongly influenced by lattice bendings. (Contractor's abstract, modified)

2080

Pennsylvania U. [Dept. of Metallurgical Engineering] Philadelphia.

THE FRICTIONAL STRESS ACTING ON A MOVING DISLOCATION IN AN OTHERWISE PERFECT CRYSTAL, by D. Kuhlmann-Wilsdorf. July 1960 [33]p. incl. diagrs. refs. (AFOSR-TN-60-978) (AF 49(636)-435) AD 243204 Unclassified

Also published in Phys. Rev., v. 120: 773-781, Nov. 1, 1960.

The problem of the frictional stress suffered by moving dislocations in otherwise perfect crystals is investigated. This is done without calculating the core energies of dislocations, but by considering stresses and strains on the slip panel. The level of frictional stresses obtained is much higher than reported previously. Since common glide dislocations in metals with close packed structures apparently do not suffer significant frictional stresses, mechanisms are discussed which tend to reduce their effect. A new such mechanism is discovered. It is based on the idea that the positions of dislocation axes are not defined with precision, but only within one to a few times the average displacement of the oscillating atoms. The expected result of this, is a depression of the frictional stress for close packed metals even at very low temperatures, almost no effect on dislocations in crystals with diamond structures, and a temperature dependence proportional to $e^{-\text{const } T/T_M}$ for NaCl type salts and, probably, for bcc metals. (Contractor's abstract)

2081

Pennsylvania U. Dept. of Physics, Philadelphia.

PHOTONEUTRON REACTIONS: C^{12}, N^{14}, O^{16}, AND F^{19} NEAR THRESHOLD, by K. N. Geller, J. Halpern, and E. G. Muirhead. [1960] [5]p. incl. diagrs. tables, refs. (AFOSR-TN-60-770) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-454], Atomic Energy Commission, and Office of Naval Research) AD 456586 Unclassified

Published in Phys. Rev., v. 119: 716-720, July 15, 1960.

Photoneutron reactions in carbon, nitrogen, oxygen, and fluorine have been studied in the region of threshold using improved efficiency for the detection of the residual activity. The betatron energy calibration used is based on thresholds of deuterium, bismuth, copper, and for scattering from the 15.12-mev level in carbon. Results show that the thresholds for nitrogen and fluorine correspond well with the expected values for the respective neutron separation energies. For oxygen, the position of threshold is also in good agreement. Assuming a linear extrapolation of the betatron calibration above 15 mev, it is found that the carbon threshold is 52 kev above the accepted value of the separation energy. The successful correlation between the assignment of known resonance energies with the positions of many of the breaks in the yield curves corroborates the assumed linearity of the betatron energy scale above 15 mev. It follows that previous betatron calibrations using the carbon threshold must be in error by approximately 100 kev at 18.7 mev.

2082

Pennsylvania U. Dept. of Physics, Philadelphia.

SYSTEMATICS OF NEUTRON SEPARATION ENERGIES, by K. N. Geller, J. Halpern, and E. G. Muirhead. [1960] [11]p. incl. illus. diagrs. tables, refs. (AFOSR-TN-60-771) (AF 49(638)454) AD 456497 Unclassified

Also published in Phys. Rev., v. 118: 1302-1312, June 1, 1960.

Photoneutron thresholds for 73 isotopes have been measured by radioactivity and neutron detection methods using a 25-mev betatron. The neutron separation energies inferred from the observed thresholds are in general agreement with the values predicted from mass data and reaction energies. Several discrepancies are observed between threshold and neutron binding energies where ground state transitions require a spin change $\geq 7/2$. For these nuclei, the threshold energies are consistent with neutron emission leaving the residual nucleus in an excited state. (Contractor's abstract)

2083

Pennsylvania U. Dept. of Physics, Philadelphia.

CONTROL AND CALIBRATION OF THE BETATRON ENERGY SCALE, by K. N. Geller and E. G. Muirhead. [1959] [5]p. incl. diagrs. table, refs. (AFOSR-TN-60-772) [AF 49(638)454] AD 456568 Unclassified

Also published in Rev. Scient. Instr., v. 31: 308-313, Mar. 1960.

A new system for control of the x-ray energy from a 25-mev betatron is described. Modifications in the method of energy control and orbit expansion lead to improved operation. Calibration of the energy scale is based on reaction thresholds for D(γ, n), Bi^{209}(γ, n), Cu^{63}(γ, n), and the threshold for excitation of the 15.116-mev state in C^{12}. The resulting energy scale is linear with respect to electron momentum to better than ± 20 kev. (Contractor's abstract)

2084

Pennsylvania U. Dept. of Physics, Philadelphia.

STUDIES IN PHOTONUCLEAR REACTIONS. Annual rept. June 1960 [248]p. incl. diagrs. tables, refs. (AFOSR-TN-60-889) (AF 49(638)454) AD 239360; PB 149006 Unclassified

A summary is given of research on neutron separation energies and betatron energy calibration. A total of 73 photoneutron thresholds were measured with an accuracy of the order of 50 kev. The neutron separation energies inferred from the threshold measurements were generally found to be in good agreement with predicted values from mass data tabulations and reaction energies. Summaries are also given on photoactivation studies of carbon and oxygen, and on inelastic scattering of electrons from nuclei. (Contractor's abstract, modified)

2085

Pennsylvania U. Dept. of Physics, Philadelphia.

STUDIES IN PHOTONUCLEAR REACTIONS. Annual rept. Dec. 19, 1960, 6p. (AFOSR-135) (AF 49(638)-454) AD 249231 Unclassified

A resume of the intensive study of neutron separation energies inferred from (γ, n) threshold measurements completed under this contract is presented. In total 73 thresholds were measured. In general agreement was obtained between measured values and those predicted from mass spectroscopic measurements and reaction energies. The few discrepancies are noted. The thresholds for oxygen, nitrogen, and fluorine are in good agreement with the most recent Q-value predictions. Fine structure measurements were also completed and in order to provide short term energy stability of better than 5 kev, the energy control circuit was transistorized. The research results are published and reviewed (item nos. 2081-2084, and 2086 under this contract, Vol. IV).

2086

Pennsylvania U. [Dept. of Physics] Philadelphia.

SECOND-DIFFERENCE ANALYSIS OF BREMSSTRAHLUNG YIELD CURVES, by K. N. Geller. [1960] [3]p. incl. diagrs. table. [AF 49(638)454] Unclassified

Published in Phys. Rev., v. 120: 2147-2149, Dec. 15, 1960.

The second-difference weighting frunction of the bremsstrahlung spectrum obtained from an empirical isochromat at 15.1 mev and corrected for thick-target effects is shown to behave like a delta function of width approximately equal to the energy interval in analysis. This behavior greatly simplifies cross-section analysis of bremsstrahlung-induced activation curves when resonance phenomena are present. Application of the method to preliminary yield data for the (γ, n) reaction in nitrogen and oxygen gives good agreement with known level structure. (Contractor's abstract)

2087

Pennsylvania U. [Dept. of Physics] Philadelphia.

OPTICAL PUMPING, by R. L. de Zafra. [1960] [9]p. incl. diagrs. refs. [AF 49(638)537] Unclassified

Published in Amer. Jour. Phys., v. 28: 646-654, Oct. 1960.

The basic theory and construtional features for an optical pumping apparatus suitable for observing Zeeman splitting of hyperfine levels, and hyperfine transition frequencies is outlined. Possible applications of the apparatus are discussed in addition to the detailed design procedures.

2088

Pennsylvania U. Office of Computer Research and Education, Philadelphia.

THUNKS. A WAY OF COMPILING PROCEDURE STATEMENTS WITH SOME COMMENTS ON PROCEDURE DECLARATIONS, by P. Z. Ingerman, E. T. Irons and others. Nov. 1960, 11p. (AFOSR-TN-60-1318) (AF 49(638)951) AD 259779 Unclassified

This paper presents a technique for the implementation of procedure statements of ALGOL 60 with some comments on the implementation of procedure declarations. It was felt that a solution which had both elegance and mechanizability was more desirable than a brute-force solution. It is to be explicitly understood that this solution is one acceptable solution to a problem soluble in many ways. (Contractor's abstract)

2089

Pennsylvania U. Office of Computer Research and Education, Philadelphia.

DYNAMIC OWN-ARRAY DECLARATIONS, by P. Z. Ingerman, E. T. Irons and others. Nov. 1960, 7p. incl. table. (AFOSR-TN-60-1319) (AF 49(638)951) AD 259778 Unclassified

A boolean function designator, ARSHIFT, is described. Its purpose is mapping one own array into another as required. This situation arises in the consideration of own arrays which are declared dynamically. (Contractor's abstract)

2090

Pennsylvania U. Office of Computer Research and Education, Philadelphia.

THE ALLOCATION OF STORAGE FOR ARRAYS IN ALGOL-60, by K. Sattley and P. Z. Ingerman. Nov. 1960, 15p. (AFOSR-TN-60-1320) (Sponsored jointly by [Air Force Office of Scientific Research] under AF 49(638)951 and Wright Air Development Division) AD 259780 Unclassified

One of the more challenging features of ALGOL 60 is the possibility of allowing the dimensions of both own and non-own arrays to be defined by variables which take on their values only dynamically, so that no fixed amount of storage in the computer can be reserved by the compiler at compilation time. The purpose of this paper is to demonstrate the realizability of this feature of the language by presenting a model of such an allocator. The basis of the approach used here is that of allowing the translator to include in the coding it puts out, copies of those of its own functions which must, because of the specification of the problem, be carried out at run time. The mechanism described in this paper is independent of the possible presence of recursive procedures in the program. (Contractor's abstract)

2091

Pennsylvania U. Office of Computer Research and Education, Philadelphia.

COMMENTS ON THE IMPLEMENTATION OF RECURSIVE PROCEDURES AND BLOCKS IN ALGOL-60, by E. T. Irons and W. Feurzeig. Nov. 1960, 15p. incl. diagrs. (AFOSR-TN-60-1321) (Sponsored jointly by [Air Force Office of Scientific Research] under AF 49(638)951 and Wright Air Development Division) AD 259783 Unclassified

Because of the importance, from the theoretical point of view, of recursive functions and because of the growing extent and direction of application of recursion in programming research and experimental mathematics, it is worth some effort to implement recursion – given that the costs in compilation and storage requirements are not too great. The mechanism for treating recursive procedures described here is such that the costs in time and storage to procedures involved in recursion are no more than necessary for a completely general recusion mechanism for ALGOL 60. (Contractor's abstract)

2092

Pennsylvania U. School of Medicine, Philadelphia.

THE EFFECT OF HYPOTHALAMIC LESIONS ON THE SECRETION OF LUTEOTROPHIN, by S. M. McCann and H. M. Friedman. [1960] [12]p. incl. illus. diagrs. tables, refs. (AFOSR-TN-60-364) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)685 and National Institutes of Health) AD 251098 Unclassified

Also published in Endocrinology, v. 67: 597-608, Nov. 1960.

Hypothalamic lesions in the median eminence of rats induced persistent diestrus. If lesions were made when the rats were in proestrus or estrus, deciduomata developed in response to uterine trauma with great regularity; deciduomata failed to develop if lesions were made on the last day of diestrus. About 50% of the rats showed some eventual recovery of estrous cycle, whereas all eventually showed a loss of the deciduoma response. Lobuloalveolar development of the mammary glands occurred in about 50% of rats with lesions. If estrogen was administered concurrently, almost all rats exhibited lobuloalveolar development. Median eminence lesions also resulted in a retardation of mammary involution following removal of litters from lactating dams. It is concluded that median eminence lesions lead to persistent luteotrophic hormone secretion, and it is suggested that the hypothalamus exerts an inhibitory influence on the secretion of luteotrophin. (Contractor's abstract)

2093

Pennsylvania U. School of Medicine, Philadelphia.

LH-RELEASING ACTIVITY IN HYPOTHALAMIC EXTRACTS, by S. M. McCann, S. Taleisnik and H. M. Friedman. [1960] [3]p. incl. tables, refs. (AFOSR-TN-60-624) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)685 and National Institutes of Health) AD 249026 Unclassified

Also published in Proc. Soc. Exper. Biol. and Med., v. 104: 432-434, July 1960.

Acid extracts of rat stalk-median eminence tissue evoked ovarian ascorbic acid depletion in immature rats pre-treated with gonadotrophins. Part of the activity in the extracts could be accounted for by their content of luteinizing hormone (LH) or vasopressin or both, whereas the remaining activity appeared to be due to release of LH from pituitary of assay rats. The substance(s) responsible for LH-releasing activity of extracts has been called LH-releasing factor. The nature of this material is unknown, but it appears to differ from histamine, serotonin, substance P, epinephrine, and vasopressin or oxytocin. (Contractor's abstract)

2094

Pennsylvania U. School of Medicine, Philadelphia.

HYPOTHALAMIC CONTROL OF PITUITARY GONADOTROPHINS. IMPAIRMENT IN GESTATION, PARTURITION AND MILK EJECTION FOLLOWING HYPOTHALAMIC LESIONS, by C. C. Gale and S. M.

McCann. [1960] [12]p. incl. illus. diagrs. tables, refs. (AFOSR-TN-60-691) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-685 and National Institutes of Health) AD 265718 Unclassified

Also published in Jour. Endocrinol., v. 22: 107-117, Mar. 1961.

Impairments in gestation, parturition, and milk ejection were produced when electrolytic lesions were placed in the median eminence of the tuber cinereum of pregnant rats at various stages of gestation. Replacement studies during pregnancy in rats with lesions in the caudal median eminence suggest that (1) all aborting rats were deficient in gonadotrophins necessary for secretion of estrogen, and (2) half of them were deficient in luteotrophin as well. In rats receiving lesions on days 7-9 and maintaining gestation to term, 32% of those with severe diabetes insipidus experienced difficulty during delivery. Placement of lesions after day 13 impaired neither gestation nor parturition. The observation that most rats with lesions were able to deliver their litters normally but were unable to eject milk following suckling stimuli suggests that oxytocin is not essential for parturition in this species. Most of the rats with lesions failed to resume estrous cycles; of the few showing return of normal or irregular cycles, the majority failed to mate. (Contractor's abstract)

2095

Pennsylvania U. School of Medicine, Philadelphia.

EFFECT OF LUTEINIZING HORMONE AND VASOPRESSIN ON OVARIAN ASCORBIC ACID, by S. M. McCann and S. Taleisnik. [1960] [4]p. incl. diagr. tables, refs. (AFOSR-TN-60-845) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)685 and National Institutes of Health) AD 251099 Unclassified

Also published in Amer. Jour. Physiol., v. 199: 847-850, Nov. 1960.

Luteinizing hormone (LH) depicted ovarian ascorbic acid of immature or adult rats pretreated with gonadotrophins, the former animals being more sensitive than the latter. Follicle-stimulating hormone, luteotrophin and adrenocorticotrophin had minimal or no activity in this assay, whereas vasopressin but not oxytocin had appreciable activity. Vasopressin was more active in the adult rats. If the doses were expressed on a weight basis, vasopressin was actually more potent than the LH standard in the adults; however, endogenous vasopressin release did not deplete ovarian ascorbic acid. The activity of both LH and vasopressin was either not affected or at least not the same degree by hypophysectomy. Retrograde injection of vasopressin into the ovarian vein showed that the action of vasopressin was a direct one on the ovary. Vasopressin does not interfere with the assay of LH in body fluids by this technique. (Contractor's abstract)

2096

Pennsylvania U. School of Medicine, Philadelphia.

EFFECTS OF HYPOTHALAMIC LESIONS ON THE SECRETION AND STORAGE OF HYPOPHYSIAL LUTEINIZING HORMONE, by S. Taleisnik and S. M. McCann. [1960] [10]p. incl. illus. diagrs. tables, refs. (AFOSR-TN-60-848) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-685 and National Institutes of Health) AD 253070 Unclassified

Also published in Endocrinology, v. 68: 263-272, Feb. 1961.

Hypothalamic lesions in the median eminence of the tuber cinereum produced a syndrome of constant vaginal diestrus (CD), accompanied by atrophic ovaries and uteri and a significant decrease in weight of the pars distalis. The ovaries of these rats were characterized by failure of follicular development and the persistence of large corpora lutea. Lesions in the rostral hypothalamus, on the other hand, produced a syndrome of constant vaginal estrus (CE), accompanied by atrophic ovaries, and enlargement of uteri and pars distalis. The ovaries of these rats were filled with large follicles, and there was a scarcity of corpora lutea of their remnants. Using the ovarian ascorbic acid depletion method, LH was measured in plasma and pars distalis before and after ovariectomy in normal rats and those with hypothalamic lesions. No detectable LH was found in plasma from normal rats, but detectable quantities of the hormone were found 1 to 16-wk postovariectomy. It was concluded that the hypothalamus exerts a regulatory influence over synthesis and secretion of hypophysial LH. (Contractor's abstract)

2097

Pennsylvania U. School of Medicine, Philadelphia.

THE EFFECT OF LACTATION ON PLASMA LH, by S. M. McCann, T. Graves, and S. Taleisnik. [1960] [2]p. incl. table. (AFOSR-TN-60-1127) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)685 and National Institutes of Health) AD 260192 Unclassified

Also published in Endocrinology, v. 68: 873-874, May 1961.

A significant ovarian ascorbic acid depletion occurred in the assay rats after injection of plasma from ovariectomized rats or ovariectomized rats whose litters were removed ($P < 0.001$ for each group). In contrast to these 2 control groups the plasma from ovariectomized, lactating rats induced only a minimal ovarian ascorbic acid depletion, which was significantly less than the ascorbic acid depletion obtained with plasma from either of the 2 control groups ($P < 0.001$ on comparison with either control group). It is clear that lactation prevents the rise in plasma LH activity which normally follows ovariectomy. If, as appears highly likely, plasma LH activity is related to hypophysial release of LH, then the results indicate that lactation suppresses this release in the ovariectomized rat.

2098

Pennsylvania U. School of Medicine, Philadelphia.

THE EFFECT OF A HYPOTHALAMIC EXTRACT ON THE PLASMA LUTEINIZING HORMONE (LH) ACTIVITY OF THE ESTROGENIZED OVARIECTOMIZED RAT, by S. M. McCann and S. Taleisnik. [1960] [3]p. incl. table. (AFOSR-TN-60-1494) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)685 and Public Health Service) AD 261726 Unclassified

Also published in Endocrinology, v. 68: 1071-1073, June 1961.

The LH activity of rat plasma was estimated by the ovarian ascorbic acid depletion method. Significant LH activity was found in plasma from rats which had been ovariectomized for 1 to 4 mo. A single subcutaneous injection of 1.0 μg of estradiol benzoate produced a marked decrease in this activity on assay 3 days later. The LH activity in plasma of such estrogen-treated, ovariectomized rats was significantly elevated within 10 min after the intravenous injection of an acidic extract of rat stalk-median eminence tissue, whereas injection of extract from cerebral cortex was without significant effect. It is suggested that stalk-median eminence tissue contains a specific LH-releasing factor. (Contractor's abstract)

2099

Pennsylvania U. School of Medicine, Philadelphia.

THE EFFECT OF ESTROGEN ON PLASMA LUTEINIZING HORMONE (LH) ACTIVITY IN THE RAT, by S. M. McCann and S. Taleisnik. [1960] [6]p. incl. diagrs. tables, refs. (AFOSR-71) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-685 and Public Health Service) Unclassified

Also published in Endocrinology, v. 69: 909-914, Nov. 1961.

Using the ovarian ascorbic acid assay for LH, detectable quantities of LH were found in plasma of ovariectomized donor rats. The LH activity of ovariectomized rat plasma was decreased by single subcutaneous injections of estradiol benzoate. This effect was demonstrable within a day after injection of a large dose of estradiol benzoate; the minimal effective dose to cause a decrease in LH activity 3 days after injection was about 0.1 μg. A slight decrease in LH activity was demonstrable within an hour of intravenous injection of a large dose of estradiol or estradiol benzoate. Decreased LH activity was found in the absence of proestrous or estrous smears but was always found if the smear was in proestrous or estrous stage. It was concluded that estradiol exerts a negative feed-back on the LH controlling area. (Contractor's abstract)

2100

Pennsylvania U. School of Medicine, Philadelphia.

HYPOTHALAMIC REGULATION OF LUTEINIZING HORMONE, by S. M. McCann and S. Taleisnik. [1960] [1]p. [AF 49(638)685] Unclassified

Published in Science, v. 132: 1496, 1960.

Ovarian ascorbic acid depletion in rats pretreated with gonadotrophins was used as the assay for luteinizing hormone (LH). Mere insertion of an electrode into the median eminence was found to evoke hypophysial LH release, whereas passage of the electrode into the posterior hypothalamus had no effect. Lesions in the median eminence and in the suprachiasmatic region prevented the rise in plasma LH which followed ovariectomy and were associated with subnormal values for hypophysial LH content. The ovariectomy was prevented by the median eminence lesions but still occurred after suprachiasmatic lesions. Acid extracts of median eminence tissue from rat and rabbit evoked ascorbic acid depletion in the assay rats. Experiments with hypophysectomized assay rats showed that at least part of the activity of the extracts was caused by LH secretion. It is suggested that a humoral agent, designated LH-releasing factor, secreted by the median eminence, regulates the secretion of LH by the adenohypophysis.

2101

Pennsylvania U. [School of Medicine] Philadelphia.

STUDIES ON NEURAL REGULATION OF LH (Abstract), by S. M. McCann, S. Taleisnik, and H. Friedman. [1960] [1]p. [AF 49(638)685] Unclassified

Published in Fed. Proc., v. 19: 292, 1960.

The ovarian ascorbic acid depletion test of Parlow (Fed. Proc., v. 17: 402, 1958) has been used as an assay for measuring LH in immature or adult female rats. This test is sensitive, reasonably precise and highly specific for LH as judged by the response to LH as compared to FSH, prolactin, or ACTH. Various stimuli such as surgical trauma, hemorrhage, epinephrine, and nicotine had little or no effect on ovarian ascorbic acid. Vasopressin, but not oxytocin, had LH-like activity in pharmacological doses. One week after ovariectomy, significant titers of LH were found in plasma and these elevated levels were maintained for at least 6 wk. Lesions in the median eminence, or hypothalamic damage associated with a state of persistent vaginal estrus, prevented this elevation in LH after ovariectomy. Three wk post-median eminence lesions, pituitary LH was within normal limits, but it was markedly decreased several months post-lesions. The mere passage of an electrode into the hypothalamus of the adult rat induced ovarian ascorbic acid depletion. The results give further evidence for hypothalamic control over LH release.

2102

Pisa U. (Italy).

CONDITIONING TECHNIQUES WITH AND WITHOUT THE HELP OF ELECTROPHYSIOLOGICAL EXPLORATION, by G. F. Ricci. [1960] [13]p. incl. illus. diagrs. refs. (AFOSR-2170) [AF EOAR-61-36] AD 449984 Unclassified

Also published in Acta of Internat'l. meeting on the Techniques for the Study of Psychotropic Drugs, Bologna (Italy) (June 26-27, 1960), Modena, Socleta Tipografica Modenese, 1960, p. 3-15.

Some of the data concerning conditioning and its electrophysiological correlations existing in the literature are discussed. The types of experiments reviewed here include classical conditioning and instrumental conditioning, conditioning associated with electroencephalographic arousal reactions, differential conditioning, and microelectrode recorded patterns of activity during conditioned trials. The wealth of data obtained from these studies and the high yield of expected results to be acquired in the future is promising. Of particular interest is the study of the action of psychotropic drugs in conditioned behavioral studies. The investigation of the changes induced upon behavior and at the same time upon its electrophysiological correlates could lead to a better knowledge of the point of attack of the various drugs in the central nervous system.

2103

Pisa U. Inst. of Physiology (Italy).

[RELATION OF BRAINSTEM RETICULAR FORMATION TO ANIMAL BEHAVIOR]. REPORT FOR THE ACADEMIC YEARS 1957-58 AND 1958-59. 1960, 9p. incl. refs. (AFOSR-TN-60-498) (Sponsored jointly by Air Force Office of Scientific Research under AF 61-(514)1125 and AF 61(052)107 and Rockefeller Foundation) AD 242270 Unclassified

The brain research conducted from 1957 - 1959 is reviewed. Some results and conclusions are: In the rostral part of the pons there is a region which seems to be critical in maintaining EEG and behavioral patterns of wakefulness; other structures in the lower brain stem exert EEG synchronizing and possibly sleep inducing influence by acting directly on the cerebrum or diencephalon, or through reciprocal inhibition of the reticular activating system; EEG arousal can be obtained by electrical stimulation of the bulbar reticular formation when lemniscal and extralemniscal sensory paths are severed at a more rostral level; the striking EEG differences between a cat with a midpontine section and a midbrain preparation must be due to the absence in the latter of an ascending reticular influence; the low voltage fast activity of the midpontine pretrigeminal cat is replaced by EEG synchronization during the retinal black-out produced by bilateral increase of intraocular pressure, which suggests an EEG activating influence of the retinal dark discharge; continuous illumination may act to abolish the dark discharge, thus explaining the EEG sleep patterns elicited in the midpontine preparation when exposed to continuous illumination; EEG arousal following intravenous injection of adrenaline and nor-adrenaline was not reproduced by intracarotid or intravertebral injections, suggesting that this arousal is not likely to be due to arrival of the catecholamines at the reticular synapses; a technique is suggested for sectioning the corpus callosum.

2104

Pisa U. Inst. of Physiology (Italy).

EEG SYNCHRONIZING STRUCTURES IN THE LOWER BRAIN STEM, by J. Magnes, G. Moruzzi, and O. Pompeiano. [1960] [28]p. incl. diagrs. refs. (AFOSR-TN-60-1144) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) Unclassified

Experiments are described in which EEG synchronization is elicited in the encéphale isolé cat by electrical stimulation at low frequency of the caudal brain stem in the region of the nucleus of the solitary tract. The nucleus studied receives afferent impulses from the baroceptive zones of the carotid sinuses. The factors affecting the EEG synchronizing structures of the medulla are studied.

2105

Pisa U. Inst. of Physiology (Italy).

CHANGES OF EVOKED POTENTIALS IN LATERAL GENICULATE BODY AND VISUAL CORTEX DURING REPETITIVE PHOTIC STIMULATION IN THE "CERVEAU ISOLÉ" CAT, by M. Mancia, M. Meulders, and G. Santibañez-H. [1959] [2]p. (Technical note no. 9) (AFOSR-TN-60-1272) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)-107 and Rockefeller Foundation) AD 246200 Unclassified

Also published in Experientia, v. 15: 479-480, 1959.

Changes observed in the photic-evoked potentials at the geniculate and cortical levels during repetitive visual stimulation of the cerveau isolé of the cat show that the reticular substance lying caudal to the brain stem transection is not essential for habituation. The parallelism between dishabituation and EEG arousal elicited either by an olfactory stimulus or by electrical stimulation of reticular structures, suggests that the reticular activating system may be related to dishabituation. (Contractor's abstract)

2106

Pisa U. Inst. of Physiology (Italy).

ENHANCEMENT OF EVOKED RESPONSES IN THE VISUAL SYSTEM DURING REVERSIBLE RETINAL INACTIVATION, by A. Ardulni and T. Hirao. [1960] [24]p. incl. diagrs. refs. (Technical note no. 11)

(AFOSR-TN-60-1273) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) AD 246201 Unclassified

Also published in Arch. Ital. Biol., v. 98: 182-205, 1960.

In the unanesthetized midpontine preparation the cortical responses to single shocks delivered to the lateral geniculate body are facilitated by steady light stimulation and reduced in darkness. This confirms the results obtained by other investigators on the anesthetized cat. The same effects are produced when a reversible visual deafferentation is obtained with the ischemic method in the same experimental conditions. After midline sagittal section of the optic chiasma with and without nembutal anesthesia, both the effects of continuous illumination and of deafferentation are present bilaterally, even when 1 eye only is illuminated or functionally inactivated. The intensity of these unilateral effects, however, is greatly reduced. The hypothesis is made that the effects of continuous illumination are at least partly due to abolition of the retinal dark discharge. The functional significance of this discharge is discussed. (Contractor's abstract)

2107

Pisa U. Inst. of Physiology (Italy).

A STEREOTAXIC METHOD FOR SECTIONING THE CORPUS CALLOSUM IN CAT, by F. Magni, R. Melzack, and C. J. Smith. [1959] [8]p. incl. diagr. (Technical note no. 8) (AFOSR-TN-60-1274) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) AD 253885 Unclassified

Also published in Electroencephalog. and Clin. Neurophysiol. Jour., v. 12: 517-518, May 1960.

Two needles are held in the electrode carriers of a standard Harsley-Clarke instrument and are positioned in front of and behind the corpus callosum. A thread running between them is brought under tension, pressing down on the callosal fibers and dividing them. Interference with cerebral circulation, operative trauma, and demands upon the operator's skill are minimized. (Contractor's abstract)

2108

Pisa U. Inst. of Physiology (Italy).

A STEREOTAXIC METHOD FOR SECTIONING THE CORPUS CALLOSUM IN CAT, by F. Magni, R. Melzack, and C. J. Smith. [1959] [6]p. incl. diagr. [Technical note no. 10] (AFOSR-TN-60-1275) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) Unclassified

For abstract see item no. 2107, Vol. IV.

2109

Pisa U. Inst. of Physiology (Italy).

EEG SYNCHRONIZATION ELICITED BY LIGHT, by A. Arduini and T. Hirao. [1960] 30p. incl. refs. [Technical note no. 12] (AFOSR-TN-60-1276) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) AD 253886 Unclassified

Also published in Arch. Ital. Biol., v. 98: 275-292, 1960.

Low voltage fast activity may last indefinitely in the dark adapted acute midpontine pretrigeminal cat. Upon continuous illumination of the eyes there is a slow alteration of the EEG, stretching over a period of few minutes, until clear-cut patterns of EEG synchronization develop. The effect is obtainable only under certain conditions of the physical stimulus. EEG synchronization reverts quickly to low voltage fast activity when olfactory stimuli are delivered (arousal reaction). The spindle trains are replaced by low voltage fast activity when the illumination is withdrawn. This process also takes a few minutes to develop. These alternations of opposite EEG patterns can be reproduced several times in the same preparation by alternating periods of steady illumination and of complete darkness. The parameters of illumination and the general conditions of the preparation have been investigated. The data are discussed and the results are compared with the effects of visual deafferentation. (Contractor's abstract)

2110

Pisa U. Inst. of Physiology (Italy).

VISUAL SYSTEM AND SLEEP, by G. Moruzzi. [1960] 15p. incl. refs. (AFOSR-TN-60-1277) (AF 61(052)107) AD 611370 Unclassified

A review is made of the results of research carried out in the midpontine preirigeminal preparation, concerned with the work of Arduini and Hirao on the EEG activating influence of the retinal dark discharge, the EEG synchronization brought about by continuous photic stimulation and the experiments of Mancia, Meulders, and Santibañez-H on the EEG synchronization elicited by prolonged repetitive photic stimulation. The midpontine pretrigeminal preparation used in all the experiments mentioned connotes a complete absence of both anesthesia and pain, a background of EEG activation and a preparation where only 2 sensory inputs (olfactory and visual) are connected with the cerebrum. According to Arduini and Hirao the dark discharge of the retina exerts a tonic activating influence on the EEG, possibly by increasing the activity of the ascending reticular system. Reversible patterns of EEG synchronization occur following functional (ischemic) retinal deafferentation, in the dark adapted animal. Arduini and Hirao have also shown that in given experimental conditions continuous photic stimulation may produce EEG synchronization. They give indirect evidence in support of the hypothesis that the abolition of the dark discharge is responsible for these effects. Mancia, Meulders and Santibañez-H have shown that EEG

sleep patterns occur only after several hours of repetitive photic stimulation. The mechanism of this EEG synchronizing effect is discussed.

2111

Pisa U. Inst. of Physiology (Italy).

[NEUROPHYSIOLOGICAL STUDY OF AN EMOTIVE REACTION IN CHAFFINCH (FRINGILLA COELEBS) Studio neurofisiologico d'una reazione emotiva nel fringuello (Fringilla coelebs), by P. Strata. [1960] [2]p. (AFOSR-TN-60-1278) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 36: 629-630, 1960.

A neurophysiological study is made of the innate reaction of an emotional character which the chaffinch shows when confronted with an owl. An attempt is carried out to see what the nerve centers are which produce the "chink" warning sound. Eight chaffinches were studied, four of which had the left hemisphere and right eye anesthetized and the other four had the right hemisphere and left eye anesthetized with chloralose. The "chink" was still present only in the group upon which the operation was made on the right hemisphere and the left eye.

2112

Pisa U. Inst. of Physiology (Italy).

[ACTIVITY OF SINGLE UNITS OF THE PRIMARY OPTICAL CORTEX DURING LIGHT, ACOUSTIC, OLFACTORY, AND PAIN STIMULATION OF THE RABBIT WITHOUT ANESTHETIC] Attivita' di singole unita' della corteccia ottica primaria durante stimolazioni luminose, acustiche, olfattive e dolorifiche nel coniglio senza narcosi, by T. Lömo and A. Mollica. [1959] [3]p. incl. refs. (AFOSR-TN-60-1279) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) Unclassified

Presented at Twenth-eighth Assemblea Generale della Società Italiana di Biologia Sperimentale, Salsomaggiore (Italy), Oct. 8-10, 1959.

Also published in Boll. Soc. Ital. Biol. Sper., v. 35: 1879-1881, 1959.

A study is made of the 34% of the units of the primary optic area of the rabbit which do not appear to be influenced by light stimulation and a residue scarcely affected by the electrical stimulation of the controlateral optic nerve. An attempt is made to clarify the functional significance of the refractory cortical elements, whose reaction to stimuli has not been ascertained. It is determined that the receptors react to acoustic and pain stimuli.

2113

Pisa U. Inst. of Physiology (Italy).

[MODIFICATION OF THE POTENTIALS EVOKED BY REPETITIVE PHOTIC STIMULATION IN THE VISUAL CORTEX AND IN THE LATERAL GENICULATE BODY OF THE CERVEAU ISOLÉ CAT] Modificazione dei potenziali evocati della stimolazione fotica ripetitiva nella corteccia visiva e nel corpo genicolato laterale del gatto cerveau isole, by M. Mancia, M. Meulders, and G. Santibañez-H. [1959] [2]p. (AFOSR-TN-60-1280) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) AD 611473 Unclassified

Presented at Eleventh Congresso Nazionale della Società Italiana di Fisiologia, Salsomaggiore (Italy), Oct. 8-10, 1959.

Also published in Boll. Soc. Ital. Biol. Sper., v. 35: 1937-1938, 1959.

An investigation was made to analyze two possible hypotheses. One explanation is that repetitious light stimulus produces, after a certain time, as a habitual phenomenon, a progressive reduction up to the disappearance of the visual potentials caused in the cortex and in the lateral geniculate body. The other hypothesis explains the habitual process as being accompanied by a depression of the ascending reticular system.

2114

Pisa U. Inst. of Physiology (Italy).

[MODIFICATION OF THE POTENTIALS EVOKED BY REPETITIVE PHOTIC STIMULATION IN THE VISUAL CORTEX AND IN THE LATERAL GENICULATE BODY OF THE MEDIOPONTINE PRETRIGEMINAL CAT] Modificazione dei potenziali evocati della stimolazione fotica ripetitiva nella corteccia visiva e nel corpo genicolato laterale del gatto mediopontino pretrigeminale, by M. Mancia, M. Meulders, and G. Santibañez-H. [1959] [2]p. (AFOSR-TN-60-1281) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) Unclassified

Presented at Eleventh Congresso Nazionale della Società Italiana di Fisiologia. Salsomaggiore (Italy), Oct. 8-10, 1959.

Also published in Boll. Soc. Ital. Biol. Sper., v. 35: 1939-1940, 1959.

A study describes the habituation process in the mediopontine pretrigeminal preparation that shows an EEG threshold outline for around 80% of the registration time. The technique for mediopontine section under anesthetic is the entry of the trigeminal nerve by a 30% vertically inclined electrode.

2115

Pisa U. Inst. of Physiology (Italy).

[SYNCHRONIZATION OF THE ELECTROENCEPHALOGRAM PRODUCED BY THE REPETITIVE VISUAL STIMULATION OF THE MEDIOPONTINE PRETRIGEMINAL CAT] Synchronisation de l'électroencéphalogramme provoquée par la stimulation visuelle répétitive chez le chat mediopontine pretrigeminal, by M. Mancia, M. Meulders, and G. Santibañez-H. [1959] [10]p. incl. diagr. refs. (AFOSR-TN-60-1282) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) Unclassified

Also published in Arch. Internat'l. Physiol. et Biochim., v. 67: 661-670, Oct. 1959.

The repetitive visual stimulation, carried out upon the mediopontine pretrigeminal cat provokes a synchronization of the EEG analogous to that observed for the normal sleeping cat. This synchronization needs at all times a greater number of visual stimuli for the mediopontine pretrigeminal cat than for the intact cat. The results are discussed while accounting for the recent experimental data.

2116

Pisa U. Inst. of Physiology (Italy).

[ELECTROENCEPHALOGRAPHIC SLEEP PRODUCED BY THE CONTINUOUS ILLUMINATION OF THE MEDIOPONTINE PREPARATION] Sonno elettroencefalografico prodotto da illuminazione continua nel preparato mediopontino, by A. Arduini and T. Hirao. [1959] [2]p. (AFOSR-TN-60-1283) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) Unclassified

Presented at Twenty-eighth Assemblea Generale della Società Italiana di Biologia Sperimentale, Salsomaggiore (Italy), Oct. 8-10, 1959.

Also published in Boll. Soc. Ital. Biol. Sper., v. 35: 1743-1744, 1959.

Experiments are conducted on cats with pretrigeminal section at a mediopontine level. The luminous stimulation was obtained with a common microscope lamp with a light bundle concentrated at the level of the cornea on a circular surface of 7 cm diameter, from the distance of 40 cm, so as to assure equal and simultaneous stimulation of the 2 retinas. The EEG recordi was observed as electroencephalographic sleep.

2117

Pisa U. Inst. of Physiology (Italy).

[RETINAL DEAFFERENTATION AND THE CHANG EFFECT] Deafferentazione retinica ed effetto chang, by A. Arduini and T. Hirao. [1959] [2]p. (AFOSR-TN-60-1284) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) AD 611474 Unclassified

Presented at Twenty-eighth Assemblea Generale della Società Italiana di Biologia Sperimentale, Salsmaggiore (Italy), Oct. 8-10, 1959.

Also published in Boll. Soc. Ital. Biol. Sper., v. 35: 1741-1742, 1959.

The responses of the striated area to single electrical stimuli applied to the lateral geniculate nuclei increase in amplitude when the eyes are illuminated and decrease when the experiment is carried out in darkness. The study attempts to show that this Chang effect is the consequence of the suppression of the retinal dark discharge. The experiments are carried out without narcotic, on cats previously subjected to a complete section of the encephalic trunk at the mediopontine level in front of the roots of the trigeminal nerve.

2118

Pisa U. Inst. of Physiology (Italy).

[DIRECT INFLUENCE OF THE PYRAMIDAL TRACTS ON THE NUCLEI OF GOLL AND BURDACH] Influenza diretta del fascio piramidale sui nuclei di Goll e di Burdach, by F. Magni, R. Melzack and others. [1959] [4]p. incl. refs. (AFOSR-TN-60-1285) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) Unclassified

Also published in Atti Accad. Naz. Lincei. Rend. Classe Sci. Fis. Mat. e Nat., v. 28: 92-95, 1959.

The research studies the central regulation of the afflux of the sensitive and sensory impulses on the brain. A controversial approach is taken to the investigation of the corticifugal influences on the gracilis and cuneatus nuclei. The experiments are carried out on 50 cats by a stereotaxic method under ether by means of an electrolytic lesion of the mesencephalum at a post-collicular level so as to retain the pes pedunculi.

2119

Pisa U. Inst. of Physiology (Italy).

[THE LOCALIZATION AND MECHANISM OF THE CHANG EFFECT] Localizzazione e meccanismo dell'effetto chang, by A. Arduini and M. H. Goldstein. [1960] [3]p. (AFOSR-351) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)107 and Rockefeller Foundation) Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 36: 1530-1532, Dec. 31, 1960.

The studies are a result of the cortical response to single electrical impulses applied to the lateral geniculate nucleus being facilitated not only by the continuous illumination, the Chang effect, but also by the visual deafferentation. The experiments are intended to

determine at what level of the visual paths facilitation takes place in order to control the data on the diffusion of the facilitating effects, and to explain the mechanism of the facilitation phenomena of the evoked responses. The cats examined are for the most part prepared by a section of the trunk of the encephalon at the mediopontine pretrigeminal level. Part of the experiment is conducted on animals anesthetized by nembutal 50 mg/kg by intraperitoneal injection. The registration and stimulation modalities are described. The on-off discharge that occurs appears to be responsible for the lateral geniculate body excitation at low blinking frequencies.

2120

Pittsburgh U. [Dept. of Chemistry] Pa.

THE POLYHEDRAL CLATHRATE "ICE" STRUCTURES IN HIGH HYDRATES, by G. A. Jeffrey, D. Feil, and R. McMullen. Oct. 1960 [22]p. incl. diagrs. tables. (AFOSR-TN-60-1479) (AF 49(638)456) AD 246986; PB 153490 Unclassified

Presented at Amer. Chem. Soc. Symposium on Status of Problems in Molecular Structure, Washington U., Seattle, June 27-29, 1960.

Structures which have the pentagonal dodecahedron as their basic structural unit are described. A table summarizes the structural work done on the gas hydrates, 1 of the 2 groups of hydrates in which these polyhedral water structures occur. Tables show the formulae, dimensions and structure analyses for the 4 types of dodecahedral water clathrate structures.

2121

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

RECORDING rf SPECTROMETER FOR NUCLEAR QUADRUPOLE ZEEMAN SPECTRA, by C. Dean. [1960] [8]p. incl. diagrs. refs. (AFOSR-TN-60-551) [AF 49(638)323] Unclassified

Also published in Rev. Scient. Instr., v. 31: 934-941, Sept. 1960.

A semi-automatic recording spectrometer system finds the loci of magnetic field orientations, relative to a single crystal sample, for which an unsplit component occurs in the Zeeman spectrum of chlorine nuclear quadrupole resonances from the sample. The system operates continuously without attention, except for approximately daily resetting, for up to several weeks to obtain the data for crystals with weak spectra. Circuit diagrams are given for the system components, and the analysis of the data is discussed. (Contractor's abstract)

2122

Pittsburgh U. Sarah Mellon Scaife Radiation Lab., Pa.

FERROMAGNETIC ANISOTROPY IN CUBIC CRYSTALS, by F. Keffer and T. Oguchi. [1959] [8]p. incl. diagr. refs. (AFOSR-TN-60-1186) (AF 49(638)323) Unclassified

Presented at meeting of the Amer. Phys. Soc., Cambridge, Mass., Mar. 30-Apr. 2, 1959.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 4: 176-177, Mar. 30, 1959. (Title varies)

Also published in Phys. Rev., v. 117: 718-725, Feb. 1, 1960.

A reevaluation has been made of Van Vleck's second-order perturbation theory of dipolar-type anisotropy in cubic ferromagnets. In the low-temperature limit of strong correlation between the direction of neighbor spins, the first anisotropy constant K_1 varies as the 10th power of the magnetization. The theory is somewhat analogous to a previous treatment of quadrupolar-type anisotropy in the strong-correlation limit. In both cases, the results are in good agreement with the Akulov-Zener classical theory. For the dipolar case, complete agreement is also established between the Dyson-type spin-wave analysis of Charap and Weiss and the Holstein-Primakoff approach. Higher order terms in the latter are shown to lead to the Charap-Weiss correction from exchange interaction between spin waves, and this correction is extended to $S > \frac{1}{2}$. Essentially the same correction is obtained very easily from a simple modification of the Van Vleck formalism to take careful account of the average energy involved in simultaneous reversal of neighbor spins. It is shown that spin-wave theory, in agreement with classical theory, predicts identical values of dipolar-type anisotropy whether measured statically in a torque experiment or dynamically in a microwave resonance experiment. (Contractor's abstract)

2123

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

NQR THERMOMETRY, by C. Dean. [1960] 9p. incl. diagrs. (AFOSR-123) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)323 and National Science Foundation) Unclassified

A new method of temperature telemetry which utilizes the nuclear quadrupole resonance rf absorption lines whose frequencies decrease smoothly with temperature has been devised. The temperature-frequency relation is determined by the molecular properties of the compound that is used as a probe, so that it is essentially fixed for all samples of that chemical for all time. An electronic spectrometer, which will seek out the NQR frequency and transmit it, will allow the frequency measurements to be made at the monitoring station, with the assurance that the conversion to temperature is perfectly reliable.

2124

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

THEORY OF THE MAGNETIC ANISOTROPY IN

$KMnF_3$, by J. J. Pearson. [1960] [8]p. incl. diagrs. refs. (AFOSR-3061) (AF 49(638)323) Unclassified

Also published in Phys. Rev., v. 121: 695-702, Feb. 1, 1961.

A theoretical calculation is made of the magnetic anisotropy in the cubic perovskite structure of $KMnF_3$ at room temperature and in its distorted structures at lower temperatures. These distortions are of 2 types: first, a small tetragonal distortion of the entire crystal; and then, below the antiferromagnetic Neel point, a distortion of the octahedron of fluorine atoms surrounding each manganese. The cubic anisotropy is obtained from a general spin-wave calculation of the zero-point dipole-dipole energy in a cubic antiferromagnet. The result is found to be the same as that for the ferromagnetic case. The anisotropy from the tetragonal distortion is obtained from the change in the classical Lorentz factors. In calculating the effect of the fluorine distortion, a generalization is introduced by Kondo's method for obtaining the anisotropic effective spin Hamiltonian produced by overlap and electron transfer between an Mn^{++} ion and its non-magnetic neighbors. In its present form the method permits the ready calculation of this anisotropy for any symmetry and number of neighbors. Comparison with the microwave resonance and torque measurements of Portis, Teaney, and Heeger, reveals the last effect to be the most important and confirms the form of the spin Hamiltonian found here and its approximate magnitude. (Contractor's abstract)

2125

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

RIGHT-ANGLED SUPEREXCHANGE, by T. N. Casselman and F. Keffer. [1960] [3]p. incl. refs. (AFOSR-3062) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)323] and National Science Foundation) Unclassified

Also published in Phys. Rev. Ltrs., v. 4: 498-500, May 15, 1960.

It is shown that the nearest neighborhood (nn) antiferromagnetic coupling arises because superexchange through the anion $p\pi$ orbitals is actually of the same magnitude as that through the $p\sigma$ orbital, in striking contradiction to the standard model. The origin of the π-like superexchange is a surprisingly large overlap between $p\pi$ anion orbitals and xy-like 3d cation orbitals. The overlap integrals between anion p orbitals centered at the origin and cation 3d orbitals centered at the lattice distance a along the x axis are defined as: $S_\sigma = \int \psi_{3x^2 - \gamma^2}(\vec{r} - a\vec{x})\psi_x(\vec{r})d\vec{r}$, $S_\pi = \int \psi_{xy}(\vec{r} - a\vec{x})\psi_y(\vec{r})d\vec{r}$. Rather than neglect $S\pi$ it is calculated using Hartree-Fock orbitals appropriate to the free ions Mn^{++} and O^{--}. The result is for MnO, $S\pi = 0.050$ compared to $S_\sigma = 0.076$. These overlaps yield, for MnO, $J_{nn}/J_{nnn} \approx 1.5$.

2126

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

BOND ASYMMETRIES FROM ZEEMAN-SPLIT NUCLEAR QUADRUPOLE RESONANCE (Abstract), by V. Rehn and C. Dean. [1960] [1]p. [AF 49(638)323] Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 345, June 15, 1960.

Improved techniques have made it feasible to use relatively high Zeeman fields (H) to obtain accurate measurements of the asymmetry parameter (η) from relatively complex NQR spectra from nuclei of spin 3/2. The relevant theoretical details have been examined, and a method developed for obtaining η from field and frequency measurements alone. Since η is assumed to be directly related to the electronic configuration in the covalent bond, data of this precision can provide an experimental test of the relative importance of σ and π bonding. The results indicate the differences encountered: $\eta = 0.076 \pm 0.003$ in p-Cl_2 benzene; $\eta = 0.0489 \pm 0.002$ in p-Cl aniline: $\eta = 0.116 \pm 0.002$ for bonds with the lower pure NQR frequency in 1245 Cl_4 benzene.

By writing the first-order expressions for the α and β Zeeman components with H perpendicular to the bond axis, but using the average of field for $\upsilon_{applied} - \upsilon_0 \pm$ const, where υ_0 is the pure NQR frequency, terms proportional to H^2 cancel, and $\eta = 2(\bar{H}_\alpha - \bar{H}_\beta)/\bar{H}_\alpha + \bar{H}_\beta)$ irrespective of azimuthal angle of H. Terms proportional to H^3 are observed at H > 2400 oe. For ultimate accuracy numerical data processing may be used. Experiment and theory show strong intensity variations which place restrictions on the experimental geometry.

2127

Pittsburgh U. [Sarah Mellon Scaife Radiation Lab.] Pa.

ON THE CARBON-CHLORINE BOND ANGLES IN 1, 2, 3, 4-TETRACHLOROBENZENE, by C. Dean, C. Richardson, and T. Sakurai. [1960] [2]p. incl. table. (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)323] and National Science Foundation) Unclassified

Published in Molec. Phys., v. 4: 95-96, Jan. 1961.

The nuclear quadrupole resonance method was applied to two molecules of 1, 2, 3, 4-tetrachlorobenzene in order to determine bond angles. For one molecule, two bonds, to chlorine at the 1 and 4 positions, were not detected since these bonds were nearly parallel to the axis of the high frequency coil. For the other molecule all four σ bond directions were observed. If the molecule has the puckered form the plane of the benzene ring will be obtained as the best fit plane through these four σ bonds. This plane was obtained by the least-squares method and the angle the σ bond makes with the benzene plane was calculated. Angles between σ bonds were also calculated.

2128

Plasmadyne Corp., Santa Ana, Calif.

INITIAL IONIZATION PROCESS IN GASES (Abstract), by H. G. Loos. [1960] [1]p. (Bound with its AFOSR-TN-60-405; AD 235949) (AF 49(638)655) Unclassified

Presented at Third AFOSR Contractors' meeting on Ion and Plasma Propulsion, Republic Aviation Corp., Farmingdale, N. Y., Mar. 22-24, 1960.

The problem under investigation involves a gas subject to a sudden electrodeless discharge with high electric fields of 10^3 to 10^4 v/cm and short rise times, exhibiting cylindrical symmetry. During the first phase of the discharge the free electrons present in the gas are accelerated. During this phase, the effect of collisions is felt gradually; a conservative calculation indicates that collisions diminish the drift velocity by a fraction $(1-vt-e^{-vt})/vt$, where t is the time and v is the appropriate collision frequency. For the large electric fields considered, the electrons acquire large velocities during that part of the acceleration phase for which collisions may be neglected. For small times the magnetic field is small and the Lorentz force may be neglected. Then, the development of current is essentially governed by the azimuthal momentum equation with an electric force, together with Maxwell's equations. The resulting current distribution is essentially concentrated in a cylindrical shell with a thickness $R/\sqrt{4aN_e}$, where R is the tube radius, a the classical electron radius and N_e the number of free electrons present/unit of length along the tube. This result applies if the transit time of a light wave across the tube radius is small compared with the rise time of the coil current. The derived solution becomes invalid for large times when the radial motion of electrons and ions becomes important or when the impeding effect of collisions becomes large.

2129

Plasmadyne Corp. [Giannini Research Lab.] Santa Ana, Calif.

DETECTION OF MOVING BODIES IN THE UPPER ATMOSPHERE (Unclassified title), by G. Van Ornum. Final rept. Jan. 1, 1960, 51p. incl. illus. tables. (Rept. no. GRC-908; D-FR-010-11) (AFOSR-TR-60-35) (AF 49(638)11) AD 317598 Confidential

2130

Plasmadyne Corp. [Giannini Research Lab.] Santa Ana, Calif.

PLASMA PROPULSION (Abstract), by G. L. Cann and A. C. Ducati. [1959] [AF 49(638)54] Unclassified

Presented at meeting of the Amer. Phys. Soc., Ann Arbor, Mich., Nov. 23-25, 1959.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 128-129, Mar. 4, 1960.

The results of two years of experimental and analytical studies on plasma propulsion are presented. Emphasis is placed on the over-all system capabilities of various propellant substances. Propellants have been chosen for detailed study using the criteria of: specific impulse capability, efficiency of converting electrical power into effective jet power, ease and efficiency of storage, availability and cost, and flexibility of propulsor performance. The propulsion studies can be broken down as follows: (1) A generalized rocket analysis was made to determine desirable specific impulse, ratio of propellant to power plant mass, ratio of total rocket-to-payload mass, effect of propellant tank structure constant and other relevant parameters as a function of the mission requirements. (2) A number of substances that looked promising from preliminary considerations were picked and their thermodynamic properties have been computed and plotted on Mollier charts. To date, argon, helium, lithium hydride, and hydrogen have been completed. Methane, water, and ammonia are being worked on at present. (3) A rather elaborate facility has been designed around a cantilever suspension of the plasma jet head, constructed and put into operation for actually measuring the specific impulse, electric energy to jet energy conversion efficiency, and other relevant parameters.

2131

Plasmadyne Corp. [Giannini Research Lab.] Santa Ana, Calif.

MAGNETOHYDRODYNAMIC CHANNEL FLOW OF A ROTATING FLUID, by M. C. Gourdine. Dec. 22, 1960, 14p. incl. diagrs. (Rept. no. PLR-86) (AFOSR-138) (AF 49(638)335) AD 255736 Unclassified

Also published in Proc. Fourth Biennial Gas Dynamics Symposium on Magnetohydrodynamics, Northwestern U., Evanston, Ill. (Aug. 23-25, 1961), Evanston, Northwestern U. Press, 1961, p. 19-24. (AFOSR-2787)

An incompressible, viscous, electrically conducting fluid, flowing steadily in a long cylindrical channel in the presence of a parallel magnetic field, is subjected to the torque produced by a radial current sheet interacting with the magnetic field. This torque causes rotation of the fluid upstream and downstream due to viscosity. In addition, the magnetic field tends to retard the motion of the conducting fluid across the magnetic lines. The distribution of rotational velocity in the channel and the distortion of the applied magnetic field is found. When the Alfvén number is less than one, the disturbance caused by the current sheet propagates to infinity downstream, but when the Alfvén is greater than one, the disturbance propagates both upstream and downstream to infinity.

2132

Plasmadyne Corp. [Giannini Research Lab.] Santa Ana, Calif.

A TECHNIQUE FOR MAKING LOCAL MEASUREMENTS

OF THE CONDUCTIVITY AND VELOCITY OF A PLASMAJET, by M. C. Gourdine. June 22, 1960, 14p. incl. diagrs. (Rept. no. PLR-71) (AFOSR-365) (AF 49(638)335) AD 255735 Unclassified

A technique is described for measuring the electrical conductivity and local velocity of a flowing plasma. The equipment consists of 3 coils (A, B and C) placed close enough so that the magnetic lines of the exciter coil (A) link the 2 sensors, B and C, on either side of it. The electrical conductivity and the velocity of the streaming plasma is determined by comparing the amplitude and phase of the voltages sensed by B and C. The equations for the signals sensed by B and C are derived from Maxwell's equations determining the electro-magnetic fields and Ohm's Law for a moving conductor determining the current density. The signals from B and C can be amplified and displayed on the X and Y axes, respectively, of an oscilloscope. (Contractor's abstract)

2133

Plasmadyne Corp. [Giannini Research Lab.] Santa Ana, Calif.

STUDY OF THE ACCELERATION IN CHANNELING OF PLASMA JETS BY MAGNETIC FIELDS (Abstract), by R. W. Waniek. [1960] [1]p. (Bound with its AFOSR-TN-60-405; AD 235949) (AF 49(638)335) Unclassified

Presented at Third AFOSR Contractors' meeting on Ion and Plasma Propulsion, Republic Aviation Corp., Farmingdale, N. Y., Mar. 22-24, 1960.

Efficient electro-kinetic energy conversion for propulsive applications in plasma thrustors make it mandatory that the angular divergence of the mass ejected shall be small. Such a consideration would seem to favor completely 3-dimensional acceleration schemes vs those of lower dimensions. Studies carried out under this contractual activity have covered 3-dimensional ejectors of the induced current type in single-stage geometries.

2134

Plasmadyne Corp. [Giannini Research Lab., Santa Ana] Calif.

HIGH INTENSITY PLASMA JETS (Abstract), by A. C. Ducati. [1960] [1]p. (Bound with its AFOSR-TN-60-405; AD 235949) (AF 49(638)766) Unclassified

Presented at Third AFOSR Contractors' meeting on Ion and Plasma Propulsion, Republic Aviation Corp., Farmingdale, N. Y., Mar. 22-24, 1960.

A short summary of the history of the project is given from the starting date to the present. The best results obtained to date are based on the use of hydrogen as propellant in a vacuum environment. Also, ammonia has been recently tested. Maximum specific impulse reached is 1500 sec with the use of hydrogen.

Mollier charts for argon, helium, lithium, hydrogen and lithium hydride have been computed and prepared and are now available to persons interested.

2135

Politecnico di Milano. Laboratorio di Elettrochimica Chimica Fisica, e Metallurgia (Italy).

A CONTRIBUTION TO THE STUDY OF THE ELECTRODE BEHAVIOR OF METALLIC SINGLE CRYSTALS, by R. Piontelli, G. Poli, and G. Serravalle. [1959] [41]p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)144, Cassa di Risparmio delle Provincie Lombarde (Milan), Consiglio Nazionale delle Ricerche (Rome), and A. Tonolli & Co. (Milan)) Unclassified

Presented at 115th meeting of the Electrochem. Soc., Philadelphia, Pa., May 3-7, 1959.

Published in Trans. of the Symposium on Electrode Processes, Philadelphia, Pa. (May 4-6, 1959). New York, John Wiley & Sons, Inc., 1961, p. 67-107.

Abstract published in Jour. Electrochem. Soc., v. 106: 71C, Mar. 1959.

A suitable technique to study the electrode behavior of oriented surfaces of metallic single crystals is described. Typical results are given concerning variously oriented surfaces of several metals (Pb, Cd, Sn, Ag, Cu, and Ni) in different conditions. The theoretical aspects involved by these results are discussed. (Contractor's abstract)

2136

Politecnico di Torino. Laboratorio di Meccanica Applicata (Italy).

ON THE INTERACTION BETWEEN STREAM AND BODY IN A FREE-MOLECULE FLOW. PART I. ENERGY EXCHANGES, by S. Nocilla. June 1960 [31]p. incl. diagrs. tables, refs. (Technical note no. 15) (AFOSR-TN-60-914, Pt. 1) (AF 61(052)208) AD 242425; PB 150346 Unclassified

Also published in part in Rarefied Gas Dynamics; Proc. Second Internat'l. Symposium, California U. Berkeley [Aug. 3-6, 1960] New York, Academic Press, 1961, p. 169-208.

A precise energy balance is defined on the surface between body and flow. The derived equations are discussed for 3 cases: (1) adiabatic, (2) with radiation present, and (3) with heat transfer present. The need is shown to introduce new interaction parameters with respect to the usual accommodation coefficient. Reemission temperatures are calculated, a new physical interpretation of the local accommodation coefficient α is obtained, the global accommodation coefficient $\bar{\alpha}$ is calculated, and it is found that, on the basis of known experimental results, (in the case with heat transfer present) values are assumed which differ from those usually assigned. Results are illustrated.

2137

Politecnico di Torino. Laboratorio di Meccanica Applicata (Italy).

ON THE INTERACTION BETWEEN STREAM AND BODY IN A FREE-MOLECULE FLOW. PART II. MOMENTUM EXCHANGES, by S. Nocilla. Sept. 1960 [31]p. incl. diagrs. refs. (Technical note no. 17) (AFOSR-TN-60-914, Pt. 2) (AF 61(052)208) AD 252851 Unclassified

Also published in part in Rarefied Gas Dynamics; Proc. Second Internat'l. Symposium, California U., Berkeley [Aug. 3-6, 1960] New York, Academic Press, 1961, p. 169-208.

Research was conducted on momentum exchanges taking into account the re-emission energy balance on a body surface, and in particular, the calculated re-emission temperature. On a model various calculations of aerodynamic forces are made, from which appears the meaning of the various interaction coefficients introduced in it. The theoretical results are then compared with the known experimental results. The comparison allows us to determine the value of the fundamental parameter which occurs in the model and shows that the real re-emission conditions are far from the diffuse re-emission, in an amount so much greater as greater is the body velocity. (Contractor's abstract)

2138

Politecnico di Torino. Laboratorio di Meccanica Applicata (Italy).

ON THE INTERACTION BETWEEN STREAM AND BODY IN A FREE-MOLECULE FLOW. PART III. RELATIONS BETWEEN THE INTERACTION COEFFICIENTS AND THE SITTING TIME OF THE MOLECULES ON THE SURFACE, by S. Nocilla. Oct. 1960 [14]p. incl. diagrs. (Technical note no. 18) (AFOSR-TN-60-914, Pt. 3) (AF 61(052)208) AD 252852 Unclassified

Also published in part in Rarefied Gas Dynamics; Proc. Second Internat'l. Symposium, California U., Berkeley [Aug. 3-6, 1960] New York, Academic Press, 1961, p. 169-208.

A general formula for the sitting time of molecules on the surface is deduced. It is then shown that the values of the sitting time through it calculated at various speeds are related by a linear relation to the values of the global accommodation coefficients $\bar{\alpha}$ experimentally obtained for the outward radiating flat plate. (Contractor's abstract)

2139

Politecnico di Torino. Laboratorio di Meccanica Applicata (Italy).

SIMULTANEOUS TRANSFER OF MOMENTUM, HEAT AND MASS. PART I. HOMOGENEOUS GASES, by G. Jarre. July 1960, 10p. incl. diagr. tables, refs. (Technical note no. 16) (AFOSR-TN-60-915) (AF 61-(052)208) AD 242426 Unclassified

The analogies are studied of momentum, heat and mass transfer for high speed streams of moist gases over surfaces on which the vapor may undergo a change of state. These analogies are analyzed as affected by Prandtl and Schmidt numbers, high speed and laminar or turbulent flow. The known results for homogeneous gas subjected to simultaneous momentum and heat transfer only, and thus affected by Prandtl number only, are referred to. Results are elaborated and interpreted for the further extension to moist gases. (Contractor's abstract, modified)

2140

Polytechnic Inst. of Brooklyn, N. Y.

POLYMORPHISM OF RARE EARTH DISILICIDES, by J. A. Perri, E. Banks, and B. Post. June 15, 1959 [2]p. incl. tables. (Technical note no. 5) (AFOSR-TN-60-204) (AF 18(600)1193) Unclassified

Also published in Jour. Phys. Chem., v. 63: 2073-2074, Dec. 1959.

The results of an x-ray diffraction study are described for the ranges of stability of the 2 polymorphic forms similar to the tetragonal, $ThSi_2$ type crystalline phase found in the disilicides of rare earth metals. Reversible transformations are observed and the temperature of the transformations appear to be related to the atomic radii of the metals. The transition temperatures of rare earth "disilicides" and the unit dimensions of rare earth disilicide polymorphs are given in tables.

2141

Polytechnic Inst. of Brooklyn, N. Y.

HIGH TEMPERATURE CRYSTAL CHEMISTRY. Final rept. July 1, 1954 - Sept. 30, 1960, 1v. incl. diagrs. tables, refs. (AFOSR-382) (AF 18(600)1193) AD 252224 Unclassified

This report describes all phases of work completed under this contract. The work may be divided into 2 categories - powder and single crystal. In the latter category, the major emphasis has been on studying thermal motions in crystals of simple structure, including calcite, sodium nitrate and zinc blende. The powder work has included studies of phase transitions in alkali-tungsten bronzes, rare-earth silicides and transition metal silicides and germanides. Associated with the studies of phase transitions has been work on determination of solid solution limits, questions of stoichiometry, and correlation of variations in electrical properties with crystallographic order. (Contractor's abstract)

2142

Polytechnic Inst. of Brooklyn. Dept of [Aerospace] Engineering and Applied Mechanics, N. Y.

ON THE PLK METHOD AND THE SUPERSONIC BLUNT BODY PROBLEM, by R. Vaglio-Laurin. Aug. 1960, 75p. incl. diagrs. refs. (PIBAL rept. no. 546) (AFOSR-TN-60-430) (AF 49(638)217) AD 243947 Unclassified

Presented at Twenty-ninth Internat'l. meeting of the Inst. Aeronaut. Sci., New York, Jan. 1961.

Also published in Jour. Aero/Space Sci., v. 29: 185-206, Feb. 1962.

Detailed analysis of the subsonic and transonic portions of the flow field about either very blunt or asymmetric configurations requires successive approximations; these can be carried out in a systematic fashion only if an appropriate convergent perturbation procedure is available. It is shown that, with either direct or inverse methods of analysis, a straightforward linearization scheme leads to divergent series solutions; however, the situation can be remedied by introducing a simultaneous stretching of coordinates in the spirit of the Poincare'-Lighthill-Kuo (PLK) method. The appropriate perturbations are: (1) for the inverse method coordinates are transformed along body, shock, and intermediate lines so as to annul perturbations of the local resultant velocity; and (2) for the integral method the coordinate along the boundary of each strip is shifted so as to annul perturbations of the velocity component that determines the critical point. The inverse method is treated in detail. The linearization approach is justified by consideration of model transonic flow problems, for which closed form solutions are available. The method is recast so as to permit analysis with initial data prescribed either on the shock (estimated shape) or on the body (estimated pressure distribution). The latter alternative is required when the body profile exhibits a singularity; e.g., a sonic shoulder. Some information about the range of validity for the proposed perturbation procedure is obtained from analysis of the flow about a disk set normal to a low temperature air stream at $M_\infty = 4.76$; it is found that errors of about 25% in the estimate can be compensated by a first order perturbation. (Contractor's abstract)

2143

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

ON THREE-DIMENSIONAL FREE-MIXING, by M. H. Bloom. Aug. 1960, 11p. (PIBAL rept. no. 474) (AFOSR-TN-60-986) (AF 49(638)217) AD 244103 Unclassified

Also published in part in Jour. Aero/Space Sci., v. 28: 430-431, May 1961.

The quasi-2-dimensional nature of certain types of free 3-dimensional viscous flows of a quasi-parallel nature is discussed. These flows are presumed to be describable in boundary layer terms and are imbedded within flows which are essentially inviscid. Flows of free-wake and jet type are considered. (Contractor's abstract)

2144

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

PERTURBED BOUNDARY LAYER SOLUTIONS APPLIED TO THE WALL JET AND BLASIUS PROFILE, by M. H. Bloom and M. H. Steiger. Oct. 1960, 33p. incl. diagrs. refs. (PIBAL rept. no. 471) (AFOSR-TN-60-1340) (AF 49(638)217) AD 248667; PB 153838 Unclassified

Also published in Development in Mechanics, Proc. of the Seventh Midwestern Mechanics Conf., Michigan State U. (Sept. 6-8, 1961), New York, Plenum Press, 1961, v. 1: 588-602.

The properties of certain laminar boundary-layer flows which are associated with flows of wall-jet character are investigated. Two types of first-order perturbation solutions are obtained. In the first limiting case, it is assumed that the zero-order solution is that of a wall-jet with zero outer velocity, and that the first-order correction satisfies the outer boundary condition. The perturbation parameter is essentially the ratio of μ_e to the maximum velocity in the wall-jet component of the flow. In the second case the constant pressure Blasius solution is taken as the zero-order solution satisfying the outer velocity conditions, and the first-order correction is a wall-jet type of flow; the perturbation parameter in this case is the inverse of the former parameter.

2145

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

A STUDY OF FLOW FIELDS ABOUT SOME TYPICAL BLUNT-NOSED SLENDER BODIES, by R. Vaglio-Laurin and M. Trella. Dec. 1960, 50p. incl. diagrs. table, refs. (PIBAL rept. no. 623) (AFOSR-2) (AF 49(638)-217) AD 250025 Unclassified

Also published in Aerospace Eng., v. 20: 20-21, 80-88, Aug. 1961.

Complete inviscid flow fields about 3 model axisymmetric configurations were determined numerically. Configurations (a sphere-cylinder, and 2 sphere-cone-cylinder combinations of decreasing bluntness) and flight conditions were selected so as to indicate separately effects of nose shape, drag coefficient, flight Mach number, and thermodynamic behavior of the gas. Results are presented for 13 cases. Particular attention is devoted to interpretation and, when possible, correlations of pressure distributions on, and shock shapes about the cylindrical afterbodies. It was found that: (1) the correlation of pressure distributions on bodies having non-spherical noses involves interpretive modifications of the law suggested by blast wave analogy (also shocks

about these bodies are not described by parabolae; (2) for all configurations there is substantial influence of gas behavior on shock shape, this, however, can be correlated in terms of the gas conditions along a generally defined streamline; (3) the shock layer can generally be divided into 2 regions wherein flow properties can either be approximated by simple laws or correlated; and (4) for each configuration knowledge of the complete flow field in 1 flight condition can be used to estimate features of flows under general flight conditions including those where equilibrium dissociation is encountered. (Contractor's abstract)

2146

Polytechnic Inst. of Brooklyn. Dept. of [Aerospace] Engineering and Applied Mechanics, N. Y.

TEMPERATURE DISTRIBUTION AND THERMAL STRESSES IN STRUCTURES WITH CONTACT RESISTANCES, by F. V. Pohle, T. J. Lardner, and F. W. French. May 1960 [28]p. incl. diagrs. tables, refs. (PIBAL rept. no. 557; (AFOSR-TN-60-504) (AF 49(638)302) AD 237149; PB 147783 Unclassified

The temperature distribution in a built-up structure in the form of an I-section composed of cover plates and a web is investigated for the case of a contact resistance at the junction of the cover plates and the web. The temperature-discontinuity condition is discussed in the light of previous experimental work, and a new junction condition is proposed. Graphs of temperatures and stresses are presented for the case of constant flux of heat to the cover plates. (Contractor's abstract)

2147

Polytechnic Inst. of Brooklyn. Dept. of [Aerospace] Engineering and Applied Mechanics, N. Y.

CREEP BENDING OF ANNULAR PLATES, by S. A. Patel and B. Venkatraman. May 1960 [21]p. incl. diagrs. (PIBAL rept. no. 559) (AFOSR-TN-60-526) (AF 49(638)302) AD 238696; PB 148315 Unclassified

An investigation was conducted on the creep bending of circular plates subject to pure bending moments. The problems considered are the following: (1) an annular plate simply supported along one edge and free at the other, with radial moments applied along the supported circumference; and (2) an annular plate clamped along one edge and free at the other, with radial moments applied along the free circumference. Both these problems are analyzed first on the basis of Prager's formulation (Jour. Appl. Phys., v. 16: 837, 1945) and secondly by the use of the Tresca criterion and the associated flow rule. (Contractor's abstract)

2148

Polytechnic Inst. of Brooklyn. Dept. of [Aerospace] Engineering and Applied Mechanics, N. Y.

A NOTE ON THE IMPACT PRESSURE LOADING OF A RIGID PLASTIC SPHERICAL SHELL, by R. Sankaranarayanan. May 1960 [9]p. incl. diagr. (PIBAL rept. no. 564) (AFOSR-TN-60-639) (AF 49-(638)302) AD 239833; PB 149164 Unclassified

Also published in Jour. Aero/Space Sci., v. 28: 77-78, Jan. 1961.

The behavior of a rigid perfectly-plastic, complete spherical shell under impulsive loading by a uniform radial pressure is discussed. The ensuing radial displacement of the shell is obtained as a function of the load and is presented graphically. (Contractor's abstract)

2149

Polytechnic Inst. of Brooklyn. Dept. of [Aerospace] Engineering and Applied Mechanics, N. Y.

ON THE CREEP ANALYSIS OF SOME STRUCTURES, by S. A. Patel and B. Venkatraman. June 1960 [38]p. incl. diagrs. tables. (PIBAL rept. no. 560) (AFOSR-TN-60-836) (AF 49(638)302) AD 242414 Unclassified

Also published in Creep in Structures; Colloquium, Stanford U., Calif. (July 11-15, 1960), New York, Academic Press, 1962, p. 43-64.

Analysis of some structures is presented in which the deformations are caused exclusively by creep. A discussion is first presented of a uniaxial creep law and its generalizations for the analyses of problems in a triaxial state of stress. Moment-curvature relations are then developed from these laws for problems in bending, and an elementary device for the inclusion of compressibility effects in creep is briefly discussed. With these as basis, the particular problems considered are the bending of thin-walled beams, the bending of annular plates, and the stress distribution in a compressible sphere. In analyzing these problems, use is made of the elastic analogue. Further, the similarity of creep to plasticity is also used in some cases. In all cases, closed form solutions are presented. (Contractor's abstract)

2150

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

ON THE DYNAMICS OF PLASTIC SPHERICAL SHELLS, by R. Sankaranarayanan. Sept. 1960 [20]p. incl. diagrs. (PIBAL rept. no. 580) (AFOSR-TN-60-1165) (AF 49-(638)302) AD 244945; PB 152779 Unclassified

Also published in Jour. Appl. Mech., v. 30: 87-90, Mar. 1963.

A discussion is given of the behavior of complete spherical shells and simply supported spherical caps under impulsive loading by uniform external pressure. The pressures are assumed to be greater than the static collapse pressures, and to act for a short period of time. The displacements of the shells are presented for particular values of the parameters of the problem. The basic equations and details of the solution are given. A treatment of some limitations and extensions of the analysis concludes the report.

2151

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

HIGH ORDER CORRECT DIFFERENCE SCHEMES FOR ANISOTROPIC PARABOLIC EQUATIONS, by R. Herman and J. R. M. Radok. Oct. 1960, 7p. (PIBAL rept. no. 581) (AFOSR-TN-60-1304) (AF 49-(638)302) AD 246922; PB 153296 Unclassified

Also published in Zeitschr. Angew. Math. und Mech., v. 41: 263, June 1961.

Difference schemes for anisotropic parabolic equations are deduced for a given order of truncation errors and their relationship to similar schemes for the 1-dimensional heat equation is demonstrated. The deduction of high order correct difference schemes for anisotropic diffusion equations is reduced to the 1-dimensional problem in the same way as for isotropic multidimensional equations.

2152

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

AN APPROXIMATE ANALYTIC SOLUTION OF RE-ENTRY TRAJECTORY WITH AERODYNAMIC FORCES, by K. Wang and L. Ting. [1960] [2]p. incl. diagrs. [PIBAL rept. no. 540] (AFOSR-TN-60-77) (AF 49-(638)445) Unclassified

Also published in ARS Jour., v. 30: 565-566, June 1960.

The Lees method (ARS Jour., v. 29: 633-641, Sept. 1959) is modified so that the solution of the re-entry problem is not restricted to an entry velocity close to that of the circular satellite velocity. Numerical results are computed for entry velocity equal to 35,000 ft/sec.

2153

Polytechnic Inst. of Brooklyn. Dept. of [Aerospace] Engineering and Applied Mechanics, N. Y.

THE INFLUENCE OF THE SHOCK CURVATURE ON THE BEHAVIOR OF HYPERSONIC BOUNDARY LAYER, by A. Ferri. Feb. 1960 [39]p. incl. diagrs. table, refs. (PIBAL rept. no. 542) (AFOSR-TN-60-301) (AF 49(638)445) AD 236242 Unclassified

Presented at First All-Union Cong. on Theoretical and Applied Mechanics, Jan. 27-Feb. 3, 1960, Moscow (U. S. S. R.).

Experimental and analytical work is described on the presence of blunt noses or leading edges, and therefore of detached and highly curved shocks, which create large entropy gradients near the body surface that affect the heat transfer on the body and the transition of the boundary layer from laminar to turbulent. The entropy effects on simple axially symmetric bodies composed by a spherical nose followed by a cone are studied. A family of 15° angle blunted cones having constant cone angle and spherical nose, but having a different nose radius, are investigated for the effect of variation of external conditions on heat transfer at different flight Reynolds number and at a Mach number equal to 7.9. The effects of the presence of shear flow at low flight Reynolds numbers are discussed. Conclusions found are good for moderate Reynolds number values.

2154

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

INTERACTIONS OF RAPIDLY MOVING BODIES IN TERRESTRIAL ATMOSPHERE, by K. P. Chopra. [1961] [37]p. incl. diagrs. tables, refs. (PIBAL rept. no. 624) (AFOSR-TN-60-398A) [AF 49(638)445] AD 260301 Unclassified

Also published in Rev. Mod. Phys., v. 33: 153-189, Apr. 1961.

The basic phenomena concerning the interactions of a body moving in a conducting fluid with a pervading magnetic field are discussed. The last section deals with the summing up of the theoretical features relevant to the motion of the artificial earth satellites and the estimates of the atmospheric properties. The problems discussed consider the deceleration of the body as of prime importance, and no attempt is made to investigate its heating, melting, or vaporization. In the physical theory of meteor flight, the melting and vaporization of the body play the main role, and the deceleration is relatively unimportant.

2155

Polytechnic Inst. of Brooklyn. Dept. of [Aerospace] Engineering and Applied Mechanics, N. Y.

ANALYTIC SOLUTIONS OF PLANAR REENTRY TRAJECTORIES WITH LIFT AND DRAG, by K. Wang and L. Ting. Apr. 1960, 67p. incl. diagrs. tables. (PIBAL rept. no. 601) (AFOSR-TN-60-508) (AF 49-(638)445) AD 237370; PB 148088 Unclassified

An approximate analytic solution was obtained for the shallow reentry trajectory with aerodynamic forces. The limitation on the entry velocity was removed by retaining the gravitation and the centrifugal terms in the equations of motion. The solution is applicable to trajectories with entry velocity differing much from the

circular orbit velocity. For constant lift and drag coefficients the solutions are expressed as 2 algebraic relations. The first one relates the angle of inclination to the atmospheric density or altitude. The second one relates the velocity to the density. For lift and drag coefficients varying as a function of altitude, the solutions may be modified accordingly For a given entry condition and vehicle area/wt ratio, the first relation is independent of the drag coefficient. Thus it can be tabulated for various lift coefficients only. The second relation gives the velocity at any point of the trajectory for a given drag coefficient. The acceleration experienced by the pilot, and the total acceleration at any point of the trajectory, can be calculated once the velocity and the density are known. It is found that the maximum acceleration can be approximated by the acceleration at $\vartheta = 0$, where ϑ is the angle of inclination. For trajectories consisting of multiple entries and exits the exit velocity and exit angle can be computed by a simple iteration. (Contractor's abstract)

2156

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

AERODYNAMIC HEATING OF RE-ENTRY VEHICLE, by K. Wang and L. Ting. [1960] [2]p. incl. diagr. (PIBAL rept. no. 607) (AFOSR-TN-60-670) (AF 49-(638)445) AD 256991 Unclassified

Also published in ARS Jour., v. 30: 1180-1181, Dec. 1961.

The maximum heating rate was found to take place at the point of the trajectory very near to the minimum elevation. The fact that the major portion of the heat input also takes place in the same part of trajectory as the velocity is used to obtain the analytic expression for the total heat input. The numerical results for the total heat input check closely with the machine calculations. (Contractor's abstract)

2157

Polytechnic Inst. of Brooklyn. Dept. of [Aerospace] Engineering and Applied Mechanics, N. Y.

APPROXIMATIONS IN VARIATIONAL PROBLEMS, by L. Ting. July 1960, 14p. incl. diagr. (PIBAL rept. no. 610) (AFOSR-TN-60-789) (AF 49(638)445) AD 240832; PB 149899 Unclassified

Also published in Aero/Space Eng., v. 20: 32-33, 89-91, Jan. 1961.

It was shown that, when terms of order ϵ are omitted in the Euler equations, the stationary value of the functional will be in error of the order of ϵ^2 only if no approximation was made in the accessory equation and the functional. It was also demonstrated that the number of the approximate Euler equations may be less than the complete ones due to the "lost" of accessory equation(s) and the associated multiplier(s). When this statement is applied to the problem of optimum rocket trajectory, it becomes evident that the relative simple solution of Dommasch and Barron (Aero/Space Eng., v. 19: 46-50, Jan. 1960) does yield the correct optimum value taking into account the first order effect of aerodynamic forces and that of the variation of gravitational and centrifugal forces due to elevation. (Contractor's abstract)

2158

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

LAMINAR FLOW IN FINITE POROUS CHANNEL WITH VARIABLE INJECTION OR SUCTION, by K.-S. Wan. Sept. 1960, 47p. incl. diagrs. (PIBAL rept. no. 614) (AFOSR-TN-60-1197) (AF 49(638)445) AD 248666; PB 153837 Unclassified

Investigation is carried out to obtain the incompressible laminar flow characteristics in a channel with porous walls of finite length in which fluid is being injected or sucked through the channel walls. An approximate solution is obtained based on the variational principle. This solution is expressed in terms of the given function characterizing the variation of the injection velocity at the porous walls for any given velocity profile at the entrance to the porous region. It depends on 2 parameters, the Reynolds number and the nondimensional maximum injection velocity, both of which are based on a reduced maximum velocity at the entrance. A similarity rule for the present problem is then established. Numerical examples are given for the case where the entrance velocity profiles are inlet or parabolic and the injection velocity is a constant or varies linearly. (Contractor's abstract)

2159

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

A REALISTIC APPROACH TO PROBLEMS OF OPTIMUM ROCKET TRAJECTORIES, by S. E. Moskowitz and L. Ting. Oct. 1960, 11p. (PIBAL rept. no. 625) (AFOSR-TN-60-1342) (AF 49(638)445) AD 247226 Unclassified

Also published in ARS Jour., v. 31: 551-553, Apr. 1961.

An approximate method for analyzing problems of optimum rocket trajectories in a plane for which the vehicle experiences minimum flight time or attains maximum altitude is suggested. Included within the scope of this report are such questions as an expedient form of the governing equations entering into the functional, when the maximum values of lift and drag forces are significant. It is established that if terms of the order ϵ, where ϵ is much smaller than 1, are neglected in the Euler-Lagrange equations, using 2 multipliers with 1 shown to be initially of the order of ϵ and hence chosen initially to be zero, the computational efforts will be substantially reduced, and the extremum will differ from the true value by an order of ϵ to the second power. (Contractor's abstract)

2160

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

ON SIMULATION STUDIES OF MOTION OF BODIES IN IONIZED ATMOSPHERE, by K. P. Chopra. [1960] 19p. incl. refs. (AFOSR-TN-60-1437) (AF 49(638)-445) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 24-27, 1961.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 278, Apr. 24, 1961.

The principle of dimensional similitude is applied to the laboratory model studies of the motion of bodies in an ionized atmosphere pervaded by a magnetic field. The correspondence relationships of various characteristic parameters in the actual and laboratory model scale cases are obtained. It is shown that the scaling relationships satisfy the conditions for aerodynamic, magnetohydrodynamic and electrodynamic similitude. These relationships indicate that it is necessary to obtain actual atmospheric densities in the laboratory to perform such studies. By adopting a suitable scaling factor for the linear dimension of the body, it should be possible to simulate flight conditions corresponding to the upper atmosphere of the earth. Outline details of a suitable experiment in a hypersonic wind tunnel are described. (Contractor's abstract)

2161

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

EXCITATION OF PLASMA WAVES BY BODIES MOVING IN IONIZED ATMOSPHERE, by K. P. Chopra. [1960] [11]p. (PIBAL repl. no. 627) (AFOSR-1) (AF 49(638)445) AD 252225 Unclassified

Presented at meeting of the Amer. Phys. Soc., Gatlinburg, Tenn., Nov. 2-5, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 6: 194, Mar. 20, 1961.

Also published in Planetary and Space Sci., v. 5: 288-291, Aug. 1961.

A body moving in an ionized atmosphere acquires an electric charge through the processes of accretion of charge particles and emission of electrons by high energy photons. Of particular interest is the situation in which the body collects an ionized cloud in front of it. The motion of this ionized cloud in the atmosphere induces an electrostatic instability and causes a column of ionized gas to move ahead of the body. The electrostatic instability is conducive to the excitation of electrostatic oscillations which, if already present, are further enhanced. A magnetic field along the direction of motion assists in the formation of the ionized cloud. If the pervading magnetic field is of suitable weak strength, it may excite extraordinary electromagnetic waves. A pervading transverse magnetic field of suitable strength may cause the excitation of magnetohydrodynamic waves. (Contractor's abstract)

2162

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

GENERALIZED INTEGRAL RELATIONSHIP IN FLOW FIELDS WITH VORTEX SHEETS, by S. Kobayakawa and L. Ting. [1960] [2]p. incl. diagrs. (AFOSR-2468) (AF 49(638)445) Unclassified

Also published in Jour. Aero/Space Sci., v. 27: 872-873, Nov. 1960.

It is shown that a generalized integral relationship relating the integral of the pressure to the normal component of the velocity is valid if the region ahead of the Mach plane contains a vortex-sheet discontinuity surface, i. e., a cylindrical surface with generator parallel to the undisturbed flow.

2163

Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.

COMPLEX CHEMICAL EQUILIBRIA BY MINIMIZING FREE ENERGY, by L. M. Naphtali. Jan. 1960, 7p. incl. diagrs. tables. (Technical rept. no. PRL-60-1) (AFOSR-TN-60-228) (AF 49(638)165) AD 233497; PB 148998 Unclassified

Also published in Jour. Chem. Phys., v. 31: 263-264, July 1959.

A technique is described for computing complex chemical equilibria by the minimization of free energy without utilizing the ideal gas assumption. An equilibrium in a system of 10 components was computed in 20 sec as a Fortran II subroutine with the IBM 704.

2164

Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.

EVAPORATION AND BREAKUP OF FUEL DROPLETS IN ONE-DIMENSIONAL GAS FLOW IN A COMBUSTION CHAMBER, by L. M. Naphtali and S. Z. Burstein. Jan. 1960, 20p. incl. diagrs. table. ([Technical note] no. PRL-60-2) (AFOSR-TN-60-229) (AF 49(638)165) AD 233498 Unclassified

A mathematical model was formulated of combustion in a rocket motor as controlled by the evaporation process of an arbitrary number of droplets of injected fuel. It was assumed that interaction between single droplets was negligible and that evaporation rates of a distribution of droplets were additive. The results of the evaporation of the fuel droplets were weighed to yield a mass rate flow which was consistent with the conditions in a combustion chamber producing a thrust of about

25,000 lb. The model was programmed as a Fortran II subroutine for the IBM 704. Computations revealed that under a wide range of conditions a cooperative breakup occurred, in which the increased velocity of gases caused droplet breakup, which further increased evaporation. As a result, the overall evaporation occurred suddenly in a narrow zone in the combustion chamber where the velocity gradient was high. It was concluded that droplet breakup was the most important single parameter in spray combustion. The combustion zone tended to be narrow and relatively insensitive to size distribution, mass drop size, velocity, or temperature of the liquid.

2165

Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.

VIBRATIONS OF ELASTIC SANDWICH CYLINDRICAL SHELLS, by Y.-Y. Yu. Jan. 1960, 32p. incl. diagrs. (Technical note no. 7) (AFOSR-TN-60-324) (AF 49-(638)453) AD 235026; PB 149662 Unclassified

Also published in Jour. Appl. Mech., v. 27: 653-662, Dec. 1960.

Previous treatment of vibration of elastic sandwich plates (item nos. PIB. 15:001 and PIB. 15:002, Vol. II) is extended to the vibration study of sandwich cylindrical shells. A general theory of such shells is developed. This theory is an extension of the previous one for sandwich plates, and from which simplified equations are deduced. On the basis of these equations, axially symmetric and torsional vibrations of the infinite sandwich cylindrical shell are investigated and numerical examples are presented. (Contractor's abstract)

2166

Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.

FLEXURAL VIBRATIONS OF RECTANGULAR SANDWICH PLATES, by Y.-Y. Yu. Aug. 1960, 17p. incl. diagrs. refs. (Technical note no. 8) (AFOSR-TN-60-953) (AF 49(638)453) AD 248073; PB 153638 Unclassified

In a series of papers (item nos. PIB. 15:001, 002, Vol. II, and 1706-1709, Vol. III) 3 systems of flexural equations of motion of sandwich plates were presented, and, on the basis of the equations, flexural vibrations of sandwich plates in plane strain were investigated. The study is extended to a discussion of the free vibrations of simply supported rectangular plates as well as infinite sandwich plates in 2 dimensions. It is seen that in the isotropic case each system of the flexural equations may be separated into 2 independent subsystems. One of the 2 subsystems leads to a frequency of that for plane-strain vibrations. The other subsystem of equations yields modes which do not involve the transverse deflection of the plate and are analogous to the thickness-twist modes of the homogeneous plate discussed by Mindlin, Schacknow and Deresiewicz (Jour. Appl. Mech., v. 18: 31-38, 1951).

2167

Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.

EXTENSIONAL VIBRATIONS OF ELASTIC SANDWICH PLATES, by Y.-Y. Yu. Oct. 1960, 12p. (Technical note no. 9) (AFOSR-TN-60-1229) (AF 49(638)453) AD 248301; PB 153639 Unclassified

Also published in Proc. Fourth U. S. Nat'l. Cong. Appl. Mech., California U., Berkeley (June 18-21, 1962), New York, Amer. Soc. Mech. Engineers, v. 1: 441-447, 1962.

Three systems of extensional equations of motion of symmetrically arranged 3-layered elastic plates are presented. The first system takes into account the thickness-stretch deformation of both the core and face layers, and the second only that of the core, in addition to the extensional deformation of the layers. The third system takes no consideration of thickness-stretch deformation and is thus of the classical type. It is shown that, for ordinary sandwich plates that have relatively thin but heavy and rigid face layers, all 3 systems of equations yield practically the same result for the lowest branch of the frequency spectrum of extensional vibration of an infinite sandwich plate covering low frequency ranges. For such plates and for such low frequency ranges, consideration of thickness-stretch deformation is therefore unnecessary, in contrast to the case of flexural vibration of such plates, for which the inclusion of thickness-shear deformation of the core is an absolute necessity even for low frequencies. (Contractor's abstract)

2168

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

SYNTHESIS TECHNIQUES FOR GAIN-BANDWIDTH OPTIMIZATION IN PASSIVE TRANSDUCERS, by H. J. Carlin. Oct. 20, 1959 [33]p. incl. diagrs. (Research rept. no. R-775-59; PIB-703) (AFOSR-TN-60-27) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)1505) AD 233001; PB 157736 Unclassified

Published in [I. R. E. WESCON Convention Record on Antennas and Propagation and Microwave Theory and Techniques, p. 39-51 (Pt. 1) 1959]

Also published in Proc. Inst. Radio Eng., v. 48: 1705-1714, Oct. 1960.

An approximating technique is presented for realizing the design of broadband equalizers and matching networks which approach optimum gain bandwidth performance. Given an arbitrary load impedance it is possible, by methods of Bode, Fano, LaRosa-Carlin,

to derive the limiting constraints for optimum flat power or voltage transfer over a prescribed band. The synthesis of equalizer networks to approximate this optimum response is a difficult matter, particularly when the load has some degree of complexity. This technique bypasses the problem (of adjusting parameters of an approximating function with load characteristics) by producing from the idealized gain bandwidth constraints a set of functions specifying the equalizer alone. All load dependence is removed from the specifications as an initial step in the synthesis. The final transducer is then synthesized from the approximating functions which are obtained. Examples of 1-port and 2-port equalizer network designs utilizing this technique are given. (Contractor's abstract, modified)

2169

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

A GENERAL CLASS OF MAXIMALLY-FLAT TIME DELAY RESPONSE LADDERS, by S. Deutsch. Sept. 11, 1959, 22p. incl. diagrs. (Rept. no. R-773-59; PIB-701) (Memo. no. 28) (AFOSR-TN-60-37) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under AF 18(600)-1505) Unclassified

Also published in I.R.E. Trans. on Circuit Theory, v. CT-7: 45-49, Mar. 1960. (Title varies)

It is shown that an elliptical pole array in which the poles are equally spaced in the j direction defines a general class of maximally-flat time delay functions when the number of poles approaches infinity. The infinite-order pole array can be realized as an infinite cascade of identical 2-terminal ladders. The time delay characteristic of the driving-point impedance of the 2-terminal ladder is flat up to the nominal cutoff frequency, ω_0. Beyond ω_0, the exact shape of the time delay characteristic is determined by the eccentricity of the original pole array. The 2-terminal ladder is, in general, a low-pass R, L, and C structure that is infinitely long. Two special cases are considered: (1) When the pole array becomes linear, the ladder is lossless. Its C and L components taper toward a constant-k type. The step response has an overshoot of 2%. (2) When the pole array becomes circular, the shunt conductance and series resistances of the ladder taper toward zero while its C and L components taper toward a constant-k type. The step response has an overshoot of 1%. (Contractor's abstract)

2170

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

OPERATION OF THE DIODE MATRIX CODER, by W. A. Bellmer. Dec. 16, 1959, 34p. incl. illus. diagrs. (Rept. no. R-792-59; PIB-720) (AFOSR-TN-60-233) (AF 18(600)1505) AD 234297; PB 155709 Unclassified

Improvements were made on the preliminary design considerations for a diode-matrix transducer, and a medium size device was constructed. The physical characteristics of this device with associated input producers and output recorder are described to serve as a maintenance reference. Programming methods are provided for each function of the device and examples are given. The coder performs all functions reliably with the exception of the decoding network which presents problems due to a form of feedback produced by the program. (Contractor's abstract, modified)

2171

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

ANALYSIS AND SYNTHESIS OF TWO TERMINAL CONTACT NETWORKS BY ALGEBRAIC TOPOLOGY AND COMBINATORIAL ANALYSIS, by K. P. Young. Jan. 6, 1960, 100p. incl. diagrs. refs. (Rept. no. R-779-59; PIB-707) (AFOSR-TN-60-406) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under AF 18(600)1505) AD 238067 Unclassified

Algebraic topology is applied to the analysis and synthesis of 2-terminal contact networks. The methods are general in nature and can be used in both the tie-set and the cut-set functions. In the synthesis process, realizability by a given number of contacts is always rigorously determined, regardless of kinds of connection; over-sets or sneaks are checked; and techniques such as splitting contacts and expanding functions are devised to make realization possible. Invariant transformations save calculations and give equivalent networks without further work. Optimum realization is always obtained independent of kinds of connection. Combinatorial analysis is then used. The analysis is based on the enumeration of all loops in a complete graph passing a fixed branch. The method for analysis proves very general and can be applied to any 2-terminal contact networks. (Contractor's abstract)

2172

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

AN ALGEBRAIC APPROACH TO SEQUENTIAL SWITCHING CIRCUIT PROBLEMS, by H. R. Charney. Apr. 18, 1960, 57p. incl. diagrs. tables. (Research rept. no. PIBMRI-811-60) (AFOSR-TN-60-529) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)1505) AD 238171 Unclassified

An algebraic method is formulated for treating sequential switching circuit analysis and synthesis problems which in many ways is analogous to familiar passive network techniques. Boolean excitation functions are converted to modulo-2 arithmetic functions; inputs are treated as a series of step functions; delay is approximated by equal operate and release periods and the time variable is quantized. Ultimately, modulo-2 recursion formulas are obtained which are found to be

analogous to certain difference equation in real integers. The modulo-2 recursion formulas are solved by means of difference equation techniques and it is found that very often the solutions are both explicit and in closed form. These solutions are in fact literal statements of the original circuit specifications. (Contractor's abstract)

2173

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

SYNTHESIS OF LOGIC NETWORKS, by M. Goldstein. Mar. 30, 1960, 38p. incl. diagrs. (Research rept. no. PIBMRI-817-60) (AFOSR-TN-60-534) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and [Signal Corps] under AF 18(600)1505) AD 238076 Unclassified

A method for synthesizing economical single-output electronic and relay logic circuits is developed. The switching function is first factored by a process based upon the methods of Karnaugh or McCluskey, resulting in a form called a prime tree. The prime tree is further simplified to obtain a non-series-parallel relay circuit or is converted into a diode circuit, when an electronic circuit is desired for the final result. To obtain the equivalent transistor or vacuum tube logic circuit, the diode circuit is converted into an intermediate circuit as a preparation for final transformation. The final transformation is accomplished according to a set of simple rules and results in a vacuum tube or transistor logic circuit. There is no restriction on the type of transistor or vacuum tube logic used in the design and the method is found to yield economical circuits, as demonstrated by comparison with published results obtained by other methods. (Contractor's abstract)

2174

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

PROPAGATION CHARACTERISTICS OF DIELECTRIC ROD WAVEGUIDE, by N. Birnbaum. Mar. 11, 1960, 12p. (Rept. no. 816) (AFOSR-TN-60-602) (AF 18-(600)1505) Unclassified

Numerical data relating to the propagation characteristics of dielectric rod waveguides are presented. The data are given in the form of graphs containing the following information: (a) the relation between the guide wavelength and the free space wavelength for the E_{01} and H_{01} modes for the range of dielectric constant values 1.05 to 10; (b) attenuation data for the E_{01} and H_{01} modes for dielectric constant values ranging from 1.05 to 10; (c) cutoff wavelengths of the lowest propagating modes; and (d) electric lines of force for the E_{01} mode for several frequencies of a polystyrene rod. A brief description of the manner in which these results were obtained is included.

2175

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

MILLIMETER WAVES, by B. Epsztein. July 25, 1960 [42]p. incl. illus. diagrs. refs. (Rept. no. PIBMRI-840-60) (AFOSR-TN-60-850) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under AF 18(600)1505) AD 242929 Unclassified

The rapid growth in the millimeter wave domain necessitated the problem of power generation in this frequency band. After a review of the conventional generators for this purpose, i.e., magnetron, klystron, backward wave oscillators, traveling wave tubes, and crystal frequency multipliers, and their limitations, some consideration is given to unorthodox generators. These non-conventional means are megavolt generators, Cerenkov radiation, cyclotron resonance, field emission and plasma generation. A new scheme combining some features of the traveling wave parametric amplifier and the Doppler effect is presented. (Contractor's abstract, modified)

2176

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

QUANTITATIVE DETERMINATION OF NICKEL BY TITRATION WITH DIMETHYL GLYOXIME REAGENT, by V. L. Garik and L. M. Silber. July 14, 1960 [8]p. incl. diagr. (Rept. no. PIBMRI-846-60) (AFOSR-TN-60-1177) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)1505) Unclassified

A titration method based on the stoichiometric precipitation of nickel with dimethyl glyoxime is developed in the laboratory. The method, with adequate refinements in precision should be of value to workers interested in a rapid and reliable determination of the nickel content of samples in instances, where instrumental methods, e.g. colorimetric methods, are not applicable. The presently developed procedure was designed for conditions, under which cupric ion is absent. The titration can only take place in an alkaline medium (pH - 9.5) and must be carefully controlled, less the reagent itself coprecipitate out with the organometallic complex.

2177

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

PROPERTIES OF THIN FILMS AND BULK FERRITES BY MICROWAVE MEASUREMENTS, by L. Silber. Oct. 13, 1960 [14]p. incl. diagrs. (Rept. no. PIBMRI-873-60) (AFOSR-TN-60-1331) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)1505) Unclassified

The necessity for making microwave measurements on ferrite materials as opposed to microwave ferrite devices is discussed. The measurement purpose is to obtain material-characterizing parameters for the design of the device and to study the basic physics of the material. Conventional devices such as ferromagnetic resonance isolators and circulators, operating at low power levels, are considered. Linearized solutions of the Landau-Lifshitz equation are used to describe the behavior of the ferrite material in the previously named devices, and, additionally, the ferrite power limiter and amplifier, which depend on their functioning from deviations from this theory.

2178

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

A CONTRIBUTION TO THE TRANSIENT CHARACTERISTICS OF FREQUENCY BANDPASS AMPLIFIERS, by Y. Morlwaki. Nov. 23, 1960 [58]p. incl. diagrs. table. (Research rept. no. PIBMRI-835-60) (AFOSR-216) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)1505) AD 255546 Unclassified

Formulas which give the output waveforms of multicircuit amplifiers having an arbitrary number of stages for an input consisting of carrier frequency modulated by a unit step function are derived. Many numerical results which make clear the transient characteristics of multi-stage amplifiers are presented.

2179

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

PROCEEDINGS OF THE SYMPOSIUM ON ACTIVE NETWORKS AND FEEDBACK SYSTEMS, NEW YORK, Apr. 19-21, 1960, Vol. X, ed. by J. Fox and M. Crowell. New York, Interscience Publishers, 1961, 658p. incl. illus. diagrs. tables, refs. (AFOSR-718) (In cooperation with I. R. E. Professional Group on Circuit Theory, New York) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [AF 18(600)1505]) Unclassified

This symposium is concerned with various phases in the field of control system. Topics discussed include network synthesis, optimization of transfer function sensitivities, frequency power formulas, and linear transformation theory.

2180

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

PROCEEDINGS OF THE SYMPOSIUM ON MILLIMETER WAVES, NEW YORK, Mar. 31-Apr. 2, 1959, Vol. IX, ed. by J. Fox and M. Crowell. Brooklyn, Polytechnic Press. 1960, 1v. incl. illus. diagrs. tables, refs. (In cooperation with I. R. E. Professional Group on Circuit Theory, New York) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)1505] Office of Naval Research, and Signal Corps) Unclassified

The reports of the ninth international symposium on Millimeter Waves are presented. Particular emphasis is placed on the fact that so many foreign speakers were present for the meeting. The studies included research of millimeter waves in communication, physics, instrumentation as well as detection of and applications of millimeter waves.

2181

Polytechnic Inst. of Brooklyn. [Microwave Research Inst. N. Y.

THEORY OF THE PLASMA RADIATION (Abstract), by A. Isihara. [1960] [1]p. [AF 18(600)1505] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 79, Jan. 27, 1960.

The radiation from a plasma gas is calculated solving Maxwell's equation together with Liouville's equation for the distribution function of charged particles. It is found that besides such radiation as the dipole radiation which is the sum of individual particle radiations, there exists a radiation which is intrinsic to a plasma gas. This radiation is determined by the time dependent solution of the reduced Liouville's equation. The properties of this radiation will be discussed.

2182

Polytechnic Inst. of Brooklyn. [Microwave Research Inst. N. Y.

SPECTRAL ANALYSIS OF THE PLASMA RADIATION (Abstract), by A. Isihara. [1960] [1]p. [AF 18(600)-1505] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 235, Apr. 25, 1960.

The plasma radiation is determined by the net time change of the distribution function for 1 particle. The differential equation to determine the distribution function is nonlinear and it is necessary to introduce simplifying assumptions. However, without making such assumptions, it is possible to derive the dynamical equation taking the moment of the differential equation. This dynamical equation is used to find the macroscopic description of the angular and the spectral distribution of the plasma radiation. It is found that the radiation depends on the Fourier components of the stress tensor and is propagated in the direction determined by the tensor and the position of the observer. The total

radiation power of wave of frequency ω which is propagated in the direction is proportional to the square of the product of ω with the Fourier component of the stress tensor.

2183

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

HYDROMAGNETIC WAVEGUIDE WITH FINITE CONDUCTIVITY AND ARBITRARY CROSS SECTION, by J. Shmoys and E. Mishkin. [1960] [3]p. (Sponsored jointly by Air Force Cambridge Research Center, [Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under AF 18(600)1505]) Unclassified

Published in Phys. Fluids, v. 3: 473-475, May-June 1960.

Low pressure magnetohydrodynamic waveguides of arbitrary cross section, having a dc axial magnetic field, exhibit both TE and TM modes. The longitudinal electric field vanishes when the conductivity of the plasma is infinite, converting the TM modes into principal ones. The propagation constants for both modes are derived from the solution of the eigenvalue problems. Linearized magnetohydrodynamic equations are used. (Contractor's abstract)

2184

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

ON THE LINEAR BEHAVIOR OF LARGE-AMPLITUDE MAGNETOHYDRODYNAMIC WAVES, by J. Shmoys and E. Mishkin. [1960] [2]p. [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research and Signal Corps under AF 18(600)1505] Unclassified

Published in Phys. Fluids, v. 3: 661-662, May-June 1960.

The purposes of this paper are to extend the discussion of magnetohydrodynamic waves to incompressible fluids with finite conductivity, (Magnetohydrodynamics, New York, Interscience Publishers, secs. 3.1 and 3.2), to demonstrate that the resulting equations are linear, irrespective of the amplitude, showing that the remarks on page 37 of above ("an initial disturbance normally consists of superposed waves traveling in both positive and negative z directions, and the nonlinear terms in Eqs. (3.2) and (3.3) make it very difficult for these waves to disentangle themselves from each other unless the velocity and ac magnetic field are small") are not well founded. It is also shown that the current, the ac magnetic field, and the electric field are all transverse. The longitudinal component of the electric field and the hydrostatic pressure appear as quadratic functions of the flow, but they are essentially due to the charge separation in the direction of propagation of the magnetohydrodynamic wave.

2185

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

NETWORK PROPERTIES OF THREE TERMINAL HALL PLATES, by J. M. Garg. Mar. 9, 1960, 25p. incl. diagrs. table, refs. (Rept. no. 809-60; Memo. no. 35) (AFOSR-TN-60-351) (AF 18(603)105) Unclassified

Based on the no-voltage-amplification property of devices in which Hall-effect is present, an idealization which can be closely approached in practice is postulated. The necessary and sufficient conditions on a constant real non-symmetric 2 x 2 matrix, so that it represents this 3-terminal gyrator-like element, are derived. An equivalent circuit is proposed which is useful to represent the terminal performance of Hall-plates. Application of these results to derive minimum insertion-loss of a 1-way line using ideal 3-terminal Hall-plates is also presented. It is shown that it is impossible to construct a 3-port circulator using only positive resistors and a 3-terminal Hall-plate. (Contractor's abstract)

2186

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

COMPUTERS IN AUTOMATIC CONTROL SYSTEMS, by J. G. Truxal. Nov. 9, 1960 [40]p. incl. diagrs. refs. (Rept. no. 879-60) (AFOSR-TN-60-1475) (AF 18(603)-105) AD 251128; PB 154557 Unclassified

Also published in Proc. Inst. Radio Engineers, v. 49: 305-312, Jan. 1960.

Modern automatic feedback control systems increasingly utilize flexible and highly developed electronic computers as active controllers. The trend from the use of simple electric circuits and elementary analog devices toward high-speed digital computers (or computers employing both digital and analog devices) is accelerated by: (1) the rapidly growing complexity of modern control systems; (2) the development of optimizing control; and (3) the increasing importance of self-adaptive control. Recent applications of computer control include the automatic control of boiler operation in an electric generating station, the adaptive autopilots for piloted aircraft, and the automatic control of load dispatching in electric power distributions. (Contractor's abstract)

2187

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

PHYSICAL REALIZABILITY CRITERIA, by D. C. Youla. [1960] [19]p. incl. diagrs. (Research rept. no. PIBMRI-836-60) (AFOSR-4209) (Sponsored jointly by Air Force Cambridge Research Center under AF 19-(604)4143, Air Force Office of Scientific Research under AF 18(603)105, Army Research and Development Labs., Office of Naval Research, and Rome Air Development Center under AF 30(602)2213) AD 243210 Unclassified

Presented at 1960 I. R. E. Internat'l. Convention, New York, N. Y., Mar. 21-24, 1960.

Also published in I. R. E. Internat'l. Convention Record, Part 2: 181-199, 1960.

Also published in I. R. E. Trans. on Circuit Theory, v. CT-7 (Spec. Suppl.): 50-68, Aug. 1960.

A brief survey of the theory of linear, passive, time-invariant n-ports is presented both from an axiomatic standpoint and a synthesis point of view. In the axiomatic approach, the n-port is defined in terms of its behavior in real-time, and its steady-state behavior is deduced as a logical consequence. In the synthesis approach, the network is restricted, a priori, to be of a special type, e.g., lumped etc., and methods of realizing it in terms of a finite number of known building blocks are investigated. Under certain assumptions, an algebraic treatment appears to yield some non-trivial results. This method is applied to the synthesis of n-ports containing both positive and negative resistors. Several theorems concerning n-port stability are also given together with a discussion of non-reciprocity and its relation to gyrotropic media. (Contractor's abstract)

2188

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

ROOT LOCUS PROPERTIES AND SENSITIVITY RELATIONS IN CONTROL SYSTEMS, by H. Ur. [1959] [9]p. incl. diagrs. (AF 18(603)105) Unclassified

Published in I. R. E. Trans. on Automatic Control, v. AC-5: 57-65, Jan. 1960.

The differential properties of root loci including pole sensitivity, angle of slope, and curvature at ordinary and irregular points are investigated in a unified manner. A relation between the sensitivity function and pole sensitivity is established. The sensitivity is shown to determine variations in the transfer function due to large (not only infinitesimal) variations in K. Additional properties of loci which are developed include loci of a variable pole position and the existence of asymptotes for open-loop transfer functions with no poles or zeros at infinity. The locus is treated as a transformation of a line (the real axis) in the K plane to the s plane, and properties of analytic functions are used to simplify calculations and results. It is shown that the properties obtained can be extended to the general root locus of a nonreal K. (Contractor's abstract)

2189

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

ON THE EVALUATION OF AN ATTITUDE CONTROL SYSTEM, by J. G. Truxal and E. Mishkin. [1960] [12]p. incl. diagrs. (AF 18(603)105) Unclassified

Published in Active Networks and Feedback Systems: Proc. of the Symposium, New York (Apr. 19-21, 1960), Brooklyn, Polytechnic Press, v. 10: 81-91, 1961. (AFOSR-718)

A design method based on a decision-making procedure for a varying pattern of the system disturbance function is suggested. An example of a guidance control system is presented. In this a close dynamic relationship is followed between a body fixed in a three-dimensional coordinate system and another, instrumented one, which serves as a reference. The defining Euler angles lead to a strongly intercoupled, three-dimensional control system. The small-signal theory is developed for the ensuing nonlinear system, which is also time-varying. The input signals to this system can be assumed to be in the form of a sequence of small step functions, while the disturbances present a randomly distributed string of pulses of very short duration. (Contractor's abstract)

2190

[Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

ON IDENTIFICATION AND EVALUATION OF THE TRANSFER DYNAMICS OF PHYSICAL SYSTEMS, by E. Mishkin and J. G. Truxal. [1960] [34]p. incl. diagrs. [AF 18(603)105] Unclassified

Published in Systems: Research and Design; Proc. of the First Systems Symposium, Case Inst. of Tech., Canoga Park, Calif. (Apr. 1960), New York, Wiley and Sons, 1961, p. 233-267.

A summary is presented of the basic techniques which the electrical engineer has found most useful in the approach to the identification problem for linear systems. This problem consists of, first, a determination of the appropriate form for the individual models; second, an evaluation of these models from analysis of the physical laws which underlie component behavior or from experimental measurement of the component characteristics; and finally, an insertion into the models of relevant characteristics to describe the statistical variation of the system components. The models discussed here are analytic and deterministic in nature. The fundamental and most widely used techniques of the electrical engineer are discussed and particular attention is focused on those approaches which are most useful in the construction of adaptive systems.

2191

Pontifical Catholic U. of Rio de Janeiro (Brazil).

SINGULARITIES OF LINEAR SYSTEM FUNCTIONS, by B. Gross and E. P. Braga. Sept. 1960 [127]p. incl. diagrs. table, refs. (AFOSR-TN-60-104) (AF 49(638)-648) AD 246691; PB 153107 Unclassified

A discussion is presented of the general, finite or infinite, homogeneous ladder structure with lumped or continuously distributed parameters. The use of infinite continued fraction expansions for the representation of highly singular network functions is discussed.

Examples of networks with various singularities are included. Complex singularities were found to occur always in conjugate pairs. Branch cuts are shown to be physically interpreted as line singularities resulting from distributions of alternating poles and zeros which have become infinitely dense. A method for the determination of the locus and number of poles without knowledge of the coordinates of the individual poles is given. Some problems of equivalence of networks are discussed. Examples are given for equivalence between an infinite continuous and an infinite lumped network and for equivalence between a finite continuous and an infinite lumped network. (Contractor's abstract)

2192

Princeton U. [Chemical Engineering Lab.] N. J.

RELAXATION TIMES IN GASES, by M. Boudart. [1957] [6]p. incl. tables, refs. [AF 49(638)32] Unclassified

Published in Proc. Second Biennial Gas Dynamics Symposium on Transport Properties in Gases, Northwestern U., Evanston, Ill. (Aug. 26-28, 1957), Evanston, Northwestern U. Press, 1958, p. 75-80. (AFOSR-TR-58-22)

The theory and experimental techniques employed in the determination and study of relaxation time in gases is reviewed and recent research is described. Among the topics discussed are: (1) the adiabatic theorem in classical and quantum mechanics, (2) the difficult exchange between translational and vibrational energy, (3) the easy exchange between translational and rotational energy, (4) a definition of relaxation time, (5) the use of rapid compression, (6) relaxation times in pure diatomic gases as predicted by theory, (7) relaxation times in pure polyatomic gases which cannot be predicted by theory, and (8) relaxation of gas mixtures.

2193

Princeton U. [Chemical Engineering Lab.] N. J.

ADSORPTION AND CHEMISORPTION, by M. Boudart. [1959] [12]p. incl. refs. (AF 49(638)32) Unclassified

Published in Surface Chem. of Metals and Semiconductors; a Symposium, Columbus, Ohio (Oct. 19-21, 1959), New York, Wiley & Sons, 1960, p. 409-420.

In this survey of current concepts in adsorption and chemisorption, it is pointed out that entropy relations, both thermodynamic and kinetic, have made a relatively late appearance on the scene of adsorption research. Exaggerated preoccupation with heats of adsorption and energies of activation has led to a frozen formalism which appears to have outlived much of its usefulness. This situation is now being corrected by more attention to molecular structure of adsorbed layers and its relation to entropies of adsorption. (Contractor's abstract)

2194

Princeton U. Chemical Engineering Lab., N. J.

SURFACE DIFFUSION AND RECOMBINATION HYDROGEN ATOMS ON GLASS, by K. Tsu and M. Boudart. [1960] [36]p. incl. diagrs. table, refs. (AFOSR-TN-60-195) (AF 49(638)32) AD 237208; PB 147660 Unclassified

Also published in Proc. Second Internat'l. Symposium on Catalysis, Paris (France), [July] 1960, Paris, Editions Technip, 1961, p. 593-616.

A kinetic study of the recombination of hydrogen atoms on glass has been carried out. At low temperatures, the catalytic rate appears to be limited by the adsorption process on the entire surface. At higher temperatures, it becomes controlled by the surface diffusion of adsorbed atoms to uniformly distributed active sites. At still higher temperature, reaction takes place directly and exclusively on the active sites. A theory is presented that describes the transition between the kinetic regimes and the regime of surface diffusion. The experimental data, characterized by a complicated Arrhenius behavior, are explained by this heretofore unexplored mechanism of heterogeneous catalysis. (Contractor's abstract)

2195

Princeton U. Chemical Engineering Lab., N. J.

MOLECULAR PROBLEMS IN HEAT AND MASS TRANSFER: RECOMBINATION OF HYDROGEN ATOMS ON GLASS, by K. Tsu and M. Boudart. [1960] 1v. incl. diagrs. tables, refs. (AFOSR-TN-60-195A) (AF 49-(638)32) AD 239678 Unclassified

For abstract see item no. 2194, Vol. IV.

2196

Princeton U. Chemical Engineering Lab., N. J.

OBSERVATIONS ON LIQUID SHEETS FORMED BY COLLIDING VERTICAL JETS, by R. M. Koros, J. M. Deckers, and M. Boudart. [1960] [61]p. incl. diagrs. tables, refs. (AFOSR-TN-60-234) (AF 49(638)32) AD 237213; PB 147918 Unclassified

Also published in part in Jour. Appl. Phys., v. 31: 1129-1130, June 1960.

When two opposed vertical jets collide, a stable liquid sheet is formed. By measurements of conductivity, it was found that the thickness of the sheet at a distance from the jet axis is inversely proportional to the radial distance between voltage measuring points. Thus, the cross-sectional area to liquid flow and also the momentum of the liquid stay constant as the sheet spreads outward. There is, however, a loss of momentum of the fluid in the region of formation of the sheet. This loss is reflected by some mixing of the jets taking place in this region. The initial extent of mixing is not large and no further mixing takes place in the sheet itself, as

revealed by measurements of conductivity. Mixing and, therefore, momentum losses in the region of formation increase with fluid viscosity. Such liquid sheets have been used previously to study surface tension of freshly formed surfaces. The present work confirms the validity of the technique in the case of liquids with low viscosity. For viscous liquids, a modification of the method suggests itself. Several other uses of these liquid sheets are proposed and extensive details and observations relative to their formation and stabilization are given in the report. (Contractor's abstract)

2197

Princeton U. Chemical Engineering Lab., N. J.

CHEMICAL KINETICS AND COMBUSTION, by M. Boudart. [1960] [24]p. incl. tables, refs. (AFOSR-TN-60-1150) (AF 49(638)32) AD 246600 Unclassified

Also published in Eighth Symposium (Internat'l.) on Combustion, California Inst. of Tech., Pasadena (Aug. 28-Sept. 3, 1960), Baltimore, Williams and Wilkins Co., 1962, p. 43-50. (AFOSR-TR-60-127)

A discussion is presented of the problems of obtaining kinetic information from combustion studies and of applying equilibrium chemical kinetics to the analysis of the reactions in flames. A review of the initiation and propagation of chain reactions is included. It is concluded that with the development of laminar flame theory, flames can be used as reactors for the elucidation of specific questions in chemical kinetics. This is especially true when the chemical systems are relatively simple as in the case of ozone and hydrazine. Combustion studies have indicated that energy chains are not important in the decomposition of ozone at flame temperatures. The investigation of more complex combustion systems can be pursued with renewed confidence. Here, approximate and even incorrect formulations of flame theory can be of assistance to the kineticist in suggesting unknown or unusual reaction steps which can then be proved or disproved independently. An example of this situation is the hypothetical branching step in the reaction between excited hydrochloric acid and chlorine molecules. In this case, the existence of the excited species has been established but their further postulated reaction remains a challenging problem.

2198

Princeton U. Chemical Engineering Lab., N. J.

STAGNATION OF A COMPRESSIBLE AND RELAXING GAS AT A PITOT TUBE: THEORETICAL AND EXPERIMENTAL STUDY, by S. C. Li. [1960] 1v. incl. diagrs. tables, refs. (AFOSR-TN-60-1151) (AF 49-(638)32) AD 246601; PB 153091 Unclassified

A complete numerical solution of the Kantrowitz problem is given for a compressible gas and a Pitot tube following Griffith. The vibrational relaxation time of sulfur dioxide has been studied over an extended temperature range. (Contractor's abstract)

2199

Princeton U. Chemical Engineering Lab., N. J.

SURFACE RECOMBINATION OF HYDROGEN ATOMS IN THE PRESENCE OF WATER VAPOR, by E. J. Nowak, S. Kurzius and others. [1960] [17]p. incl. diagrs. refs. (AFOSR-TN-60-1302) (AF 49(638)32) AD 247514; PB 171512 Unclassified

The probability γ of recombination of hydrogen atoms on Pyrex glass has been measured between 390 and 460°C. The data are represented by the expression $\gamma = 2.6\ 10^{-2} \exp-(E/RT)$ where E = 9 kcal/g-mol. The measurements were made in the presence of water vapor. These rates of recombination are slower by more than 3 orders of magnitude than corresponding rates on Pyrex in the absence of water vapor. These results demonstrate for the first time that water vapor poisons glass walls for the recombination of hydrogen atoms. (Contractor's abstract)

2200

Princeton U. Chemical Engineering [Lab.] N. J.

RECOMBINATION OF ATOMS AT THE SURFACE OF THERMOCOUPLE PROBES, by K. Tsu and M. Boudart. [1960] [16]p. incl. diagrs. (AFOSR-51) (AF 49(638)32) Unclassified

Presented at Symposium on Atomic Reactions, Montreal (Canada), Sept. 1960.

Also published in Canad. Jour. Chem., v. 39: 1239-1246, June 1961.

When atoms produced by a discharge at one end of a closed cylindrical tube diffuse down the tube, their rate of recombination on the walls of the tube can be determined by measuring the temperature of a probe traveling along the axis of the tube. However the catalytic activity of the probe may, under specified conditions, appear to be the same whatever the catalytic activity of the probe material. This effect is offered as a possible explanation of the findings of Wood and Wise who recently reported essentially the same recombination probability for hydrogen atoms on 12 different metals. (Contractor's abstract)

2201

Princeton U. Chemical Engineering Lab., N. J.

INTERFACIAL RESISTANCE TO EVAPORATION, by W. J. Heideger and M. Boudart. Dec. 1, 1960 [30]p. incl. diagrs. table, refs. (AFOSR-333) (AF 49(638)32) AD 255158 Unclassified

Also published in Chem. Eng. Sci., v. 17: 1-10, Jan. 1962.

A pure liquid evaporates into a vacuum at a rate equal to that predicted by kinetic theory multiplied by a coefficient α called the evaporation coefficient. Values of α smaller than unity have been reported and they

provide a measure of interfacial resistance to evaporation. A new technique has been developed to measure α which is free from the usual objections concerning a lowered surface temperature or a contaminated interface. With pure glycerol, $\alpha = 0.05$. This result is explained theoretically and provides reliable evidence of true interfacial resistance in the evaporation of a pure liquid. (Contractor's abstract)

2202

Princeton U. [Chemical Engineering Lab.] N. J.

VIBRATIONAL RELAXATION AT A PITOT TUBE (Abstract), by M. Boudart. [1960] [1]p. (AF 49(638)-32) Unclassified

Presented at First AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, General Dynamics Corp., General Atomic Div., San Diego, Calif., Sept. 6-7, 1960. (AFOSR-TN-60-1063; AD 246174)

The method originated by Kantrowitz and developed by Griffith consists in measuring the loss in stagnation pressure of a subsonic gas jet at a Pitot tube. With a single, simple instrument, it is possible to measure readily the rate of vibrational relaxation of polyatomic molecules over a range exceeding three orders of magnitude, in an extended interval of temperatures and with pure gases or gaseous mixtures. Theoretical and experimental studies have demonstrated the reliability and accuracy of the method. A study of the effect of compressibility on flow pattern has revealed the importance of corrections overlooked previously. A series of investigations especially with nitrous oxide, carbon dioxide-water mixtures and oxygen-water mixtures, is in excellent agreement with data obtained by other techniques. The reality of the often postulated resonant transfer of vibrational energy has been evidenced by a study of the oxygen-heavy water system. The behavior of sulfur dioxide, a representative polar molecule is normal with respect to the temperature dependence of its relaxation time.

2203

Princeton U. Dept. of Aeronautical Engineering, N. J.

CONSIDERATION OF HYDRAZINE DECOMPOSITION, by I. J. Eberstein and I. Glassman. Dec. 11, 1959, 23p. incl. diagrs. refs. (Rept. no. 490) (AFOSR-TN-60-352) (AF 18(600)1527) AD 235951; PB 146001 Unclassified

Presented at ARS Propellants, Combustion and Liquid Rockets Conf., Columbus, Ohio, July 18-19, 1960.

Also published in Prog. in Astronaut. and Rocketry v. 2: 351-363, 1960.

A brief investigation of the molecular structure of hydrazine is presented. The catalysis of hydrazine decomposition on metal surfaces is discussed also. It is found that metals having incomplete d-subshells act as strong catalysts for hydrazine decomposition, whereas metals having no d-subshells, or complete d-subshells act as non-catalysts. Initial steps for hydrazine decomposition under various conditions are proposed and inhibitors for such decomposition are suggested. Inhibitors may be ammonia, aniline, toluene, xylidene or toluldene.

2204

Princeton U. Dept. of Aeronautical Engineering, N. J.

FURTHER STUDIES ON THE LIGHT SCATTERING TECHNIQUE FOR DETERMINATION OF SIZE DISTRIBUTIONS. II. WIDE RANGE PHOTOGRAPHIC PHOTOMETRY, by R. A. Dobbins, L. Crocco, and I. Glassman. Feb. 10, 1960, 50p. illus. diagrs. tables, refs. (Rept. no. 498) (AFOSR-TN-60-353) (AF 18-(600)1527) AD 235952; PB 146902 Unclassified

Also published in Rev. Scient. Instr., v. 34: 162-167, Feb. 1963.

The quantitative measurement by photographic photometry of the angular variation of luminous intensity due to a group of suitably illuminated particles is discussed. Methods of developing a photosensitive film to a high degee of uniformity are shown to depend upon the effectiveness of the mixing of the developing solution and the disruption of the formation of a concentration boundary layer. By careful selection of developing technique and by use of film and microphotometer calibration procedures based on a primary standard of measurement, it was found possible to extend the useful range of a film for photometric purposes to a density of over 2.5. These methods permit the use of photographic photometry to make measurements of irradiance varying over a wide range with good accuracy. Preliminary results indicate that a range of over 100 to 1 can be achieved with an accuracy of better than 10% over the entire range. Photographic instrumentation applied to the measurement of a diffraction pattern yielded results which were at least as good as electronic photometry with a photomultiplier as a transducer. (Contractor's abstract)

2205

Princeton U. Dept. of Aeronautical Engineering, N. J.

LIGHT SCATTERING AND TRANSMISSION PROPERTIES OF SPRAYS, by R. A. Dobbins. Nov. 23, 1960 [214]p. incl. illus. diagrs. tables, refs. (Rept. no. 530) (AFOSR-17) (AF 18(600)1527) AD 249940; PB 154278 Unclassified

The theory predicting that the angular variation of the diffractively scattered light is a function only of particle size distribution is verified. Specular transmission experiments verify (1) the applicability of the transmission law to a polydispersion of particles and (2) that the scattering area of a large particle is twice its geometric cross section. The feasibility of determining the particle size distribution of polydispersion whose particle diameters are distributed according to the Upper Limit Function is investigated. It is concluded that the angular variation of intensity of scattered light is not sufficiently sensitive to permit a unique

determination of the shape parameters of the distribution function. For all useful values of the shape parameters, the scattered light profiles can be correlated to a high degree of accuracy on the basis of volume-to-surface mean diameter. Consequently, a scattering experiment plus a specular transmission experiment can be used to give both the particle volume-to-surface mean diameter and the particle concentration. Experiments performed with sprays formed by an atomizer nozzle using photographic photometry to measure the angular variation of scattered light show a -0.4 power dependency of particle diameter on atomizer pressure drop as reported in the literature. The light scattering method permits a rapid determination of volume-to-surface mean diameter and concentration. (Contractor's abstract, modified)

2206

Princeton U. [Dept. of Aeronautical Engineering] N. J.

HIGH TEMPERATURE CHEMICAL KINETICS (Abstract), by I. Glassman. [1960] [1]p. (AF 18(600)-1527) Unclassified

Presented at First AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, General Dynamics Corp., General Atomic Div., San Diego, Calif., Sept. 6-7, 1960. (AFOSR-TN-60-1063; AD 246174)

The principle of a flow reactor for the measurement of high temperature reaction kinetics is reviewed. This device is unique in that it follows the reaction process, not by a freezing technique usually employed in flow systems, but by tracing the temperature history of the reaction. Early results on ethylene oxide decomposition to 1200°K are reviewed. A free radical mechanism independent of third body effects is postulated and is consistent with experimental results. Initial results which show that oxygen can inhibit the hydrogen-oxygen system are presented as well. The decomposition of hydrazine is discussed from analytical and experimental considerations.

2207

Princeton U. Dept. of Aeronautical Engineering, N. J.

THE MECHANISM OF IGNITION OF COMPOSITE SOLID PROPELLANTS BY HOT GASES, by R. F. McAlevy, III, P. L. Cowan, and M. Summerfield. Apr. 4, 1960 [20]p. incl. illus. diagrs. refs. (Rept. no. 505) (AFOSR-TN-60-335) (AF 49(638)411) AD 235023 Unclassified

Presented at [ARS] Solid Propellant Rocket Research Conf., Princeton U., N. J., Jan. 28-29, 1960.

Also published in Prog. in Astronaut. and Rocketry, v. 1: 623-652, 1960.

Ignition of composite solid propellants of the ammonium perchlorate type was accomplished in a shock tube filled with a mixture of oxygen and nitrogen. The time to ignition, i.e., the time interval between the instant of contact of the propellant sample by hot gas and the subsequent emission of light as detected by a photocell, was measured as a function of oxygen concentration for several different propellants. It was found that the ignition times varied inversely with the oxygen concentration. A new theoretical approach was also developed for the ignition of a composite propellant by a hot gas, the essential element being that the flame first starts in the gaseous layer adjacent to the propellant. The observed ignition delay is simply the time required for enough fuel to vaporize to create a combustible gaseous mixture. This theory explains the trend of the experimental data well. The theory suggests certain directions for improving the ignition capability of practical igniters and for enhancing the ignitability of solid propellants. (Contractor's abstract)

2208

Princeton U. Dept. of Aeronautical Engineering, N. J.

EXPERIMENTS ON THE IGNITION OF COMPOSITE SOLID PROPELLANTS, by P. L. Cowan. Jan. 1960 [59]p. incl. illus. diagrs. tables, refs. (AFOSR-650) (AF 49(638)411) AD 293914 Unclassified

An experimental study of composite solid propellant ignition was undertaken. A shock tube was used to generate high temperature gas to supply the ignition energy to the propellant samples under test. Two propellant configurations are described; a flush mounted sample in the end wall and a string mounted sample on the axis of the tube. The propellant mounting procedure is described and the problems encountered are discussed in detail. Three types of propellant were tested and the results are presented. Ignition times are measured by means of 2 phototubes viewing the propellant through quartz windows in the shock tube. The problems associated with the detection of ignition by this method are discussed. A high speed framing camera for observation of ignition is described and the photographic results are presented. Film processing techniques are outlined. The purpose of this report is to present only the experimental technique for the study of ignition in a shock tube and some typical results. (Contractor's abstract)

2209

Princeton U. [Dept. of Aeronautical Engineering] N. J.

MECHANISM OF IGNITION OF COMPOSITE SOLID PROPELLANTS (Abstract), by M. Summerfield, R. F. McAlevy, III, and K. P. Hall. [1960] [1]p. [AF 49-(638)411) Unclassified

Presented at Second AFOSR Contractors' meeting on Solid Propellant Combustion, Atlantic Research Corp., Alexandria, Va., June 7-8, 1960. (AFOSR-TN-60-663; AD 239150)

The general objective of this research has been to elucidate the physical and chemical processes that lead to ignition of a propellant when exposed to a source of energy. In particular, this project is concerned with the ignition of ammonium perchlorate propellants upon sudden exposure to hot gas generated in a shock tube. The data

suggest a new theory of solid propellant ignition based on the idea that the run-away flame occurs in the gas phase adjacent to solid surface, and that the solid phase reactions are thermally unimportant. This gas phase ignition theory leads to an understanding of the reported characteristics of practical igniters such as the difficulties with ignition at high altitudes, at low ambient temperatures, and with certain fuels and certain oxidizers. It is hoped that this theory will help clear up some of these difficulties.

2210

Princeton U. Dept. of Aeronautical Engineering, N. J.

SCALE EFFECTS IN TURBULENT SHOCK WAVE BOUNDARY LAYER INTERACTIONS, by A. G. Hammitt and S. Hight. [1959] [21]p. incl. illus. diagrs. tables, refs. (AFOSR-TN-60-82) (AF 49(638)465) AD 232973 Unclassified

Also published in Proc. of Sixth annual Conf. on Fluid Mechanics, Texas U., Austin (Sept. 1959), p. 362-382.

The investigation considers the interaction caused by an incident-reflected shock wave impingement on a turbulent boundary layer when separation exists and to determine the important parameters which govern such an interaction. Use was made of 2 separate wind tunnels at the Gas Dynamics Lab. at Princeton U. at a Mach number of 2.9. It is concluded that the length of a shock wave-boundary layer interaction measured in boundary layer thicknesses seems to vary significantly with Reynolds number when a separated region is present. The interaction becomes shorter for untripped boundary layers as Re_{δ^*} ($> 0.4 \times 10^5$) increases. The pressure ratios at separation and reattachment are relatively independent of Re_{δ^*} as are the gradients in this region. The size of the separated region is more strongly influenced by Re_{δ^*}.

2211

Princeton U. [Dept. of Aeronautical Engineering] N. J.

THE CALCULATION OF VELOCITY AND TEMPERATURE PROFILES THROUGH A WEAK NORMAL SHOCK WITH AN EXPANSION IN POWERS OF A SHOCK STRENGTH PARAMETER, by M. Sichel. Nov. 1959, 1v. incl. illus. (Rept. no. 488) (AFOSR-TN-60-83) (AF 49(638)465) AD 233800 Unclassified

A series expansion in powers of shock strength was used to solve the Navier Stokes equations for the velocity and temperature profiles of weak shock waves ($M_1 \leq 2$). This series when compared with exact analytical solutions was found to adequately predict the effects of variable Prandtl number and of variable viscosity. The velocity and temperature are expressed directly as functions of position and shock strength. Also discussed is the effect of the Prandtl number and the viscosity-temperature relation on the expansion coefficients. The shock is assumed to occur in a perfect gas with constant specific heats. (Contractor's abstract)

2212

Princeton U. Dept. of Aeronautical Engineering, N. J.

FREE MOLECULE FLOW OVER NON-CONVEX BODIES, by I. M. Cohen. Feb. 1960 [34]p. incl. diagrs. refs. (Rept. no. 497) (AFOSR-TN-60-190) (AF 49(638)465) PB 149754 Unclassified

Also published in ARS Jour., v. 30: 770-772, Aug. 1960.

The determination of the velocity distribution function f and the heat transfer rate at any point on a surface of arbitrary shape immersed in a free molecule flow field is considered. A theory is developed in which the mass flux incident on the surface of a non-convex body is expressed as the solution of an integral equation. Then, the fundamental transport properties at the surface are given in terms of appropriate integrals over velocity space. As an example, a hemisphere in an infinite speed ratio flow is considered. (Contractor's abstract)

2213

Princeton U. [Dept. of Aeronautical Engineering] N. J.

HYPERSONIC VISCOUS FLOW PAST A BLUNT BODY WITH AN APPLIED MAGNETIC FIELD. PART II, by C.-S. Wu. Aug. 1959 [28]p. incl. diagrs. tables, refs. (Rept. no. 443, pt. 2) (AFOSR-TN-60-210) (AF 49-(638)465) AD 235786; PB 148347 Unclassified

The main purpose of the present investigation is to study how much skin friction and heat transfer rate will be reduced by the presence of hydromagnetic interaction. In fact, the present analysis has simplified the physical model considerably. (For part I see item no. PRI. 16: 003, Vol. II)

2214

Princeton U. Dept. of Aeronautical Engineering, N. J.

AN ANALYSIS OF THE EFFECTS OF PERFECT GAS PARAMETERS ON GAS TURBINE PERFORMANCE, by A. G. Hammitt. Dec. 1959 [25]p. incl. diagrs. (Rept. no. 500) (AFOSR-TN-60-225) (AF 49(638)465) AD 240220; PB 149755 Unclassified

The effect of different gases on the performance of a gas turbine cycle is considered. If the gas is perfect, 3 parameters: specific heat ratio, speed of sound, and viscosity are sufficient to characterize its properties. The effects of specific heat ratio and speed of sound are more significant unless the viscosity exhibits very large variations. A gas of low specific heat ratio and and high speed of sound is advantageous for the

operation of the heat exchangers while a high specific heat ratio and low speed of sound makes the turbo machinery simpler. The best gas would depend on the relative cost of the different types of equipment. (Contractor's abstract)

2215

Princeton U. Dept. of Aeronautical Engineering, N. J.

DIMENSIONLESS PARAMETERS FOR VISCOUS SIMILARITY, by A. G. Hammitt. Dec. 1959 [5]p. incl. table. (Rept. no. 491) (AFOSR-TN-60-226) (AF 49-(638)465) AD 235788 Unclassified

Also published in Jour. Aero/Space Sci., v. 27: 720, Sept. 1960.

Viscous similarity of 2 flows can be achieved by matching Reynolds number only if viscosity is essentially constant throughout the flow. If large differences of static temperature occur and viscosity follows a 2 parameter Sutherland law, then both Reynolds number and ratio of static temperature to Sutherland temperature must be matched. Errors of the order of factors of 2 or 3 in Reynolds numbers near the stagnation point can occur in hypersonic flows if no attention is paid to the 2nd parameter. (Contractor's abstract)

2216

Princeton U. [Dept. of Aeronautical Engineering] N. J.

HEAT TRANSFER IN THE UNSTEADY COMPRESSIBLE LAMINAR BOUNDARY LAYER ON A FLAT PLATE, by N. A. Evans. [1960] [15]p. incl. diagrs. table. (AFOSR-TN-60-267) (AF 49(638)465) Unclassified

Also published in Proc. of 1960 Heat Transfer and Fluid Mechanics Inst., Stanford U., Calif. (June 15-17, 1960), Stanford U. Press, 1960, p. 77-91.

The problem of a flat plate moving into a stagnant field with velocity $u_w(t)$ is considered, and solutions for heat transfer are obtained for small $\xi_0 = (x/\int_0^t u_e dt)^2$ (where t is time, $u_e(t) = -u_w(t)$ and x is the distance from the leading edge). The solutions are valid under the conditions that $u_e(0) = 0$, $u_e(t) \geq 0$ for all $t \geq 0$, and $u_e(t)$ is infinitely differentiable for all $t \geq 0$. Numerically integrated universal functions are obtained for the energy equation, with time- and distance-dependent plate boundary conditions expressible in series form, for the determination of heat transfer with prescribed surface enthalpy distribution and surface enthalpy distribution with prescribed heat transfer. Results are obtained for Prandtl numbers of 0.75 and 1.00, and for each case the first term in the series is the steady (Blasius) value, the integration being terminated after the third unsteady term. (Contractor's abstract, modified)

2217

Princeton U. Dept. of Aeronautical Engineering, N. J.

THE ANOMALY IN THE APPLICATION OF PLK AND PARABOLIC COORDINATES TO THE TRAILING EDGE BOUNDARY LAYER, by A. Goldburg and S.-I. Cheng. Apr. 1960 [14]p. incl. diagr. (Rept. no. 519) (AFOSR-TN-60-650) (AF 49(638)465) AD 606239; PB 152738 Unclassified

The application of the Poincare-Lighthill-Kud (PLK) method to the leading edge of a flat plate predicted the well known optimum parabolic coordinate system for boundary layer analysis. The coordinate system applicable to the trailing edge problem as predicted by the PLK method is found to differ from the conventional parabolic boundary layer coordinates by an order of magnitude. (Contractor's abstract)

2218

Princeton U. Dept. of Aeronautical Engineering, N. J.

SELF-SIMILAR FLUIDS, by M. S. Wecker and W. D. Hayes. July 1960, 10p. (Rept. no. 528) (AFOSR-TN-60-894) (AF 49(638)465) AD 250980 Unclassified

Self-similarity is defined for a fluid medium, and equations of state of the form $f(p, v, T) = F(S)$ are found which are self-similar under various invariant transformations of the equations of motion. The Hugoniot relation is used to further restrict the equations of state; the resulting restriction is that F(S) must be constant if shock waves are present in a flow. (Contractor's abstract)

2219

Princeton U. [Dept. of Aeronautical Engineering] N. J.

METHODS OF ANALYSIS OF NEARLY FREE MOLECULAR FLOW FOR A SATELLITE OR OTHER SPACE VEHICLE, by D. R. Willis. Aug. 1960, 28p. incl. diagrs. table, refs. (Technical information series rept. no. R60SD399) (AFOSR-TN-60-1161) (Sponsored jointly by Air Force Ballistic Missiles Division under AF 04(647)269 and Air Force Office of Scientific Research under AF 49(638)465) AD 241900; PB 150170 Unclassified

When a satellite or other space vehicle descends below a certain altitude, some intermolecular collisions must be considered. Various methods suggested for the analysis of such nearly free molecular flow problems are discussed. A formal iterative method of solving Boltzmann's equation for the distribution function is presented. It is shown that the first collision methods represent an approximation to the calculation of the first iterate in the proposed method, when the zeroth iterate is taken as the free molecular solution. The results of calculations for a sphere in a high speed ratio flow, with emergent molecules of various energies are presented. These offer quantitative justification of some of the assumptions used in the methods in the literature, which were limited to low energy emergent molecules.

However, it appears that the results of those methods cannot be extrapolated to higher energy emergent molecules, without paying due regard to the molecular model employed. (Contractor's abstract)

2220

Princeton U. Dept. of Aeronautical Engineering, N. J.

HYPERSONIC FLOW OVER CONES, by S. A. Berger. Sept. 1960 [73]p. incl. diagrs. refs. (Rept. no. 523) (AFOSR-TN-60-1214) (AF 49(638)465) AD 255519 Unclassified

The Taylor-Maccoll equation for the supersonic flow of an ideal gas about a right circular cone with an attached shock wave is solved for the 2 cases of infinite free stream Mach numbers. The solution for the former is given in terms of an expansion in the limiting density ratio across the shock ϵ_1, and the solution to the latter in terms of a double expansion in the actual density ratio, ϵ, and ϵ_1. The results are compared with a Taylor series solution to the Taylor-Maccoll equation and also with the exact values of Kopal for air and Mueller for helium. (Contractor's abstract)

2221

Princeton U. [Dept. of Aeronautical Engineering] N. J.

COMPRESSIBILITY EFFECT IN A BOUNDARY LAYER IN A CORNER, by R. Habert. Aug. 1960, 29p. (Rept. no. 539) (AFOSR-474) (AF 49(638)465) AD 259530 Unclassified

The effect is evaluated of compressibility on the flow past 2 semi-infinite plates of 0 thickness, having an angle between 0 and 2, the incoming flow being parallel to the intersection of the 2 planes. The study is restricted here to the behavior of the flow near the corner. The flow is steady everywhere. The study covers the insulated plate case, the Prandtl number being taken as unity. The case with heat transfer is under investigation. The extent to which this compressibility effect modified the matching of the inside flow with that of the outside is not considered. (Contractor's abstract)

2222

Princeton U. [Dept. of Aeronautical Engineering] N. J.

HYPERSONIC VISCOUS FLOW NEAR THE STAGNATION POINT IN THE PRESENCE OF MAGNETIC FIELD, by C.-S. Wu. [1960] [13]p. incl. diagrs. tables, refs. (AFOSR-2469) (AF 49(638)465) Unclassified

Published in Jour. Aero/Space Sci., v. 27: 882-893, 950, Dec. 1960.

The hypersonic viscous flow past blunt-nosed bodies with hydromagnetic interaction is investigated. Local-similarity solutions of flow field and temperature distributions are near the stagnation-point region. The discussion may be grouped into parts: the two-dimensional problem (circular cylinder) and axisymmetric problem (sphere). Numerical computations have been carried out for the sphere problem for the "viscous-layer regime," with various magnetic field strengths and electrical conductivities. (Contractor's abstract)

2223

Princeton U. [Dept. of Aeronautical Engineering] N. J.

A STUDY OF NEAR FREE MOLECULE FLOW, by D. R. Willis. [1959] [32]p. incl. diagrs. refs. (AFOSR-4156) (Sponsored jointly by Air Force Ballistic Missiles Division under AF 04(647)269 and Air Force Office of Scientific Research under AF 49(638)465) Unclassified

Also published in Rand Symposium on Aerodynamics of the Upper Atmosphere, Santa Monica, Calif. (June 8-10, 1959), Santa Monica, Rand Corp., 1959, p. 13-1 - 13-32.

When a satellite or other space vehicle descends below a certain altitude, some intermolecular collisions must be considered. Various methods suggested for the analysis of such nearly free molecular flow problems are discussed. A formal iterative method of solving Boltzmann's equation for the distribution function is presented. It is shown that the first collision methods represent an approximation to the calculation of the first iterate in the proposed method, when the zeroth iterate is taken as the free molecular solution. The assumption in the first collision method that collisions between 2 molecules, both of which come from the body, can be neglected appears to require further analysis before being accepted. The choice of the intermolecular collision mechanism appears to play a hither-to unsuspectedly large role in determining the final corrections to free molecular results, particularly for a cold body in a high speed ratio stream. Further analysis of numerical results referred to in the text of this report are contained in an addendum.

2224

Princeton U. [Dept. of Aeronautical Engineering] N. J.

HIGHER-ORDER CORRECTIONS TO TAYLOR'S SOLUTION FOR WEAK, NORMAL, SHOCK WAVES, by M. Sichel. [1960] [2]p. incl. diagrs. table. (AF 49(638)-465) Unclassified

Published in Jour. Aero/Space Sci., v. 27: 635-636, Aug. 1960.

Higher-order corrections found from Navier-Stokes, Burnett, and Grad 13-Moment equations are either slowly convergent or fail to give the shock structure as a function of displacement and fluid properties. Here, rapidly convergent 2nd- and 3rd-order corrections are obtained by direct substitution of series into the Navier-Stokes or continuum equations, which would be valid for $M_1 < 2$.

2225

Princeton U. Dept. of Biology, N. J.

RESETTING THE SPORULATION RHYTHM IN PILOBOLUS WITH SHORT LIGHT FLASHES OF HIGH INTENSITY, by V. G. Bruce, F. Weight and C. S. Pittendrigh. [1959] [3]p. incl. diagrs. (AFOSR 2379) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)587], Eugene Higgins Trust, and Office of Naval Research under Nonr-185828) Unclassified

Also published in Science, v. 131: 728-730, Mar 11, 1960.

The clock-controlled endogenous sporulation rhythm in the fungus Pilobolus sphaerosporus was investigated as part of a comparative study aimed at elucidating characteristic common features of circadian rhythms. It was shown that a single, high-intensity, 1/2000 sec light flash will completely reset (shift the phase of) a rhythm persisting in continuous dim red light at constant temperature, and that one or more transient cycles occur before the phase shift is complete. The significance of these results is discussed. (Contractor's abstract, modified)

2226

Princeton U. [Dept. of Biology] N. J.

CIRCADIAN RHYTHMS AND THE CIRCADIAN ORGANIZATION OF LIVING SYSTEMS, by C. S. Pittendrigh. [1960] [26]p. incl. illus. diagrs. tables, refs. (AFOSR-2381) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)587], Eugene Higgins Trust, National Science Foundation, and Office of Naval Research) AD 611458 Unclassified

Also published in Cold Spring Harbor Symposia on Quantitative Biology, Cold Spring Harbor, N. Y. (June 5-14, 1960), New York, Long Island Biological Assoc., Inc., v. 25: 159-184, 1960.

The utilization of circadian rhythms as a vehicle for bold and explicit theory formation is discussed. There is no doubt that there is an inherited clock-system present in organisms. Several examples of oscillator systems in different species are presented which has led to the conclusion that there must be many distinct oscillatory physiological systems in the individual that are not themselves directly coupled to the light-regime as an entraining agent Hence, the idea of a multi-oscillator system being present as quasi-autonomous oscillatory systems in the organism is supported. Several generalizations concerning the properties of circadian rhythms are given. They are described as being ubiquitous, endogenous, self-sustaining, innate entrainable by a restricted class of environmental periodicities, and intractable to chemical perturbation.

2227

Princeton U. Dept. of Biology, N. J.

AN EFFECT OF HEAVY WATER ON THE PHASE AND PERIOD OF THE CIRCADIAN RHYTHM IN EUGLENA, by V. G. Bruce and C. S. Pittendrigh. [1960] [7]p. incl. diagrs. refs. (AFOSR-2382) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49-(638)587], Eugene Higgins Trust, National Science Foundation and Office of Naval Research under Nonr-185828) Unclassified

Also published in Jour. Cellular and Compar. Physiol., v. 56: 25-31, Aug. 1960.

The circadian rhythms of the Euglena are investigated by placing H_2O-grown Euglena in D_2O minimal media. The immediate reaction is non-mobility and lack of phototactic response for 2 or 3 days. This inactivity is reversed by transfer back to H_2O minimal media. This knowledge permits an investigation of the phase relationship of the phototactic rhythm of the cells. It is clearly shown that the resultant rhythm shift is correlated with the time of transfer of the culture from D_2O back to H_2O. Cells adapted to D_2O by long term growth show that the free-running-period of the rhythm of cells is increased by such adaptation. That heavy water does have an immediate effect on the cells is clearly evident. The way in which this effect is brought about is, however, not at all clear, and the possible explanations that might explain this mechanism are briefly discussed.

2228

Princeton U. Dept. of Mathematics, N. J.

QUALITATIVE THEORY OF DIFFERENTIAL EQUATIONS, by V. V. Nemytskii and V. V. Stepanov, tr. by S. Lefschetz. Princeton U. Press, 1960, 523p. incl. diagrs. refs. (AF 18(600)532 and AF 33(038)9993) Unclassified

This is a translation of the latest edition of the important Russian work. Originally prepared on the basis of the first Russian edition, the English language version presented here includes extensive material from the much enlarged second Russian edition, as well as the text of Nemytskii's outline of the still more recent work of the Moscow school. About 40% of the papers under review refer to work done outside the USSR. However, the emphasis is still, on the whole, on Soviet research. The book is divided into 2 parts, each having a bibliography of significant works. Part 1 covers classical differential equations, and part 2 covers topological dynamics and ergodic theory.

2229

Princeton U. Dept. of Mathematics, N. J.

ON IDENTICAL VANISHING OF HOLOMORPHIC FUNCTIONS IN SEVERAL COMPLEX VARIABLES, by S. Bochner. [1958] [2]p. [AF 18(600)1379] Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 45: 46-47, Jan. 1959.

In the complex space $C_n(z_1, \ldots, z_n)$ if $f_1, \ldots, f_n$ are

holomorphic in the unit ball and have continuous boundary values on the boundary, and if on the boundary the linear combination $\bar{z}_1 f_1 + \ldots + \bar{z}_n f_n$ is O, then the functions $f_1, \ldots, f_n$ are identically O. The above result of J. J. Kohn (Proc. Amer. Math. Soc., v. 9: 175-177, 1958) is discussed. Two theorems are considered: (1) If the function $\Phi(\bar{z};z)$ is 0 on B_0, then the function $\Phi(\zeta;z)$ is identically 0 in $(\zeta;z)$. Hence, if the polynomials $P_1, \ldots, P_m$ are linearly independent over constants, then $f_1, \ldots, f_m$ are all identically 0. (2) If D is the unit ball, and $P_1, \ldots, P_m$ are any polynomials in $\zeta_1, \ldots, \zeta_n$, then the vanishing of $\Phi(z;z)$ on a neighborhood B_0 of the boundary of D implies a representation.

2230

Princeton U. Dept. of Mathematics, N. J.

LINEAR AND ALGEBRAIC DEPENDENCE OF FUNCTIONS ON COMPACT COMPLEX SPACES WITH SINGULARITIES, by S. Bochner. [1958] [3]p. [AF 18-(600)1379] Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 45: 47-49, Jan. 1959.

The following situation is axiomatized. Take a (non-compact) complex space W^m, entirely regular, and form the quotient space $V = W^m/R$ relative to some equivalence relation R, say relative to the action of a group of homeomorphisms. For some complex dimension n, $n \leq m$, there is in W^m a finite number of separate complex n-cells, each holomorphically immersed, such that the union of their projections covers V. In the axiomatization V is eliminated altogether. In the space of n complex variables $z = (z^1, \ldots, z^n)$ a finite number of neighborhoods U_a, $a = 1, \ldots, A$ is taken, each represented by the unit ball $\|z_a\| < 1$, and, for every a, some subneighborhood T_a, as represented by $\|z_a\| < r_a$, $r_a < 1$. With each z_a in each U_a, some point z_b of some T_b ($b \neq a$ or $b = a$) is permanently associated, in symbols $z_b = \Phi(z_a)$. This compact pseudo-space is denoted by S.

2231

Princeton U. [Dept. of Mathematics] N. J.

DIFFERENTIABLE ISOTOPES ON THE 2-SPHERE, by J. Munkres. [1958] [5]p. (AF 18(600)1494) Unclassified

Presented at meeting of the Amer. Math. Soc., New York, Aug. 26, 1958.

Published in Michigan Math. Jour., v. 7: 193-197, 1960.

Let Diff S^n denote the group of diffeomorphisms of degree +1 and of class C^r ($1 \leq r \leq \infty$) carrying the unit n-sphere onto itself, topologized by requiring closeness of the maps and their partial derivatives through order r. A path in this space is called a regular isotopy; it is a map of the reals R into the space which is constant on the set $t \leq 0$ and on the set $t \geq 1$. It is proven that if 2 maps are regularly isotopic, they are differentiably isotopic as well. The group Γ^{n+1} of Milnor and Thom is defined as a quotient group of the group $\pi_0(\text{Diff } S^n)$ of path components of this space. An elementary proof that $\pi_0(\text{Diff } S^2)$ and hence Γ^3 vanishes is given. The group $\pi_0(\text{Diff } S^n)$ does not depend on the choice of r; for simplicity only the case r = 1 is proven.

2232

Princeton U. [Dept. of Mathematics] N. J.

OBSTRUCTIONS TO THE SMOOTHING OF PIECEWISE-DIFFERENTIABLE HOMEOMORPHISMS, by J. Munkres. [1960] [34]p. incl. diagrs. refs. (AF 18(600)1494) Unclassified

Published in Ann. Math., v. 72: 521-554, Nov. 1960.

A previous paper (item no. 1746, Vol. III) unified and extended, within the framework of an obstruction theory, the results of Milnor, Thom and others concerning differentiable structures. Here, a further extension of the theory is presented to include manifolds with boundaries and their proofs.

2233

Princeton U. [Dept. of Mathematics] N. J.

OBSTRUCTIONS TO IMPOSING DIFFERENTIABLE STRUCTURES, by J. Munkres. [1960] 37p. (AFOSR-TN-60-921) (AF 49(638)431) AD 438546 Unclassified

An application is made of previously-developed techniques (item no. 1746, Vol. III) to the problem of differential structures. The approach used is to assume a Brouwer triangulation of M and take the imbeddings 1_V: Cl(St v) → R^n as a first try at coordinate systems covering M. An attempt is made to "smooth out" those which do not overlap differentiably. It is pointed out that the differentiable structures obtained are not compatible with the given triangulation or some division of it. It is thought that this incompatibility can be altered.

2234

Princeton U. [Dept. of Mathematics] N. J.

HOMOLOGY THEORY FOR LOCALLY COMPACT SPACES, by A. Borel and J. C. Moore. [1959] [23]p. (AFOSR-3386) [AF 49(638)431] Unclassified

Also published in Michigan Math. Jour., v. 7: 137-159, 1960.

A homology theory for locally compact spaces is developed in this paper. The main purpose of introducing this theory is to obtain a Poincaré duality theorem for cohomology manifolds. Emphasis is placed upon homology theory rather than on cohomology manifolds. In addition some properties of a certain connected sequence of bifunctions on the category of sheaves which yields the homology groups when the first variable is put equal to K are discussed.

2235

Princeton U. [Dept. of Mathematics] N. J.

CLASSES OF HOLOMORPHIC FUNCTIONS OF SEVERAL VARIABLES IN CIRCULAR DOMAINS, by S. Bochner. [1960] [3]p. [AF 49(638)578] Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 46: 721-723, May 1960.

Let C^k be the space of k-tuples of complex numbers $z = (z_1, \ldots, z_k)$. Let D be a "bounded circular domain of C^k with origin", i.e., such that $a \in D$ and $|z| \leq 1 \Rightarrow za \in D$. Let ω be a Borel measure on B, the boundary of D, which is "circularly invariant", i.e., such that B_0 is a measurable subset of $B \Rightarrow \omega(B_0) = \omega(e^{i\Theta}B_0)$ for all real Θ. The following is stated: Theorem 3: D, B, ω being as above, let f be holomorphic on D and in "the Hardy class H_λ, $\lambda > 0$, with respect to the measure ω", i.e., such that $\sup_{0<r<1} \int_B |f(\lambda\zeta)|^\lambda d\omega(\zeta) = C < \infty$. Then $\int_B \sup_{0<r<1} |f(r\zeta)|^\lambda d\omega(\zeta) \max_\lambda C^\lambda$; also there exists a function F on B, integrable with respect to ω, such that $\int_B |f(r\zeta) - F(\zeta)|^\lambda d\omega(\zeta) \to 0$, as $r \to 1-$. In particular D can be a sphere in C^k and ω the ordinary (2k - 1)-dimensional surface area; or D can be the polycylinder $P_k = [|z_1| < 1, \ldots, |z_k| < 1]$, and ω concentrated on the k-dimensional subset $[|z_1| = 1, \ldots, |z_k| = 1]$ of its total (2k - 1)-dimensional boundary. The special case $\lambda = 1$, $D = P_k$ and $d\omega = d\theta_1 \ldots d\theta_k$ was established earlier by the author in Ann. of Math., v. 45: 708-722, 1944 along with other powerful results. The author claims that Theorem 3 is derivable by first extending its (quite classical) form for k = 1 and D = $[|z| < 1]$ (Theorem 1) to functions $\Phi(\ ,\xi)$, again of one complex variable, but depending on a parameter ξ which varies over a measure space X, and such that Φ is measurable on $[|z| < 1] \cap X$, and for almost all $\xi \in X$, $\Phi(\ ,\xi)$ is holomorphic on $[|z| < 1]$, and $\sup_{0<r<1} \int_X d\xi \int_0^1 |\Phi(re^{2\pi i\theta}, \xi)|^\lambda d\theta = C^\lambda < \infty$. This extention (Theorem 2) is expected to yield Theorem 3. For $\lambda > 1$, the counterpart of Theorem 3 for the real part u of f is stated, and for $\lambda = 1$ and analogous result under the condition $\sup_{0<r<1} \int_B |u(r\zeta)| \log^+ |u(r\zeta)| d\omega(\zeta) = C < \infty$. (Theorem 4) Also for $\lambda > 1$, it states an extension of M. Riesz's theorem on the inequality between the Hardy-class norms of the real and imaginary parts u, v of f (Theorem 5).

2236

Princeton U. [Dept. of Mathematics] N. J.

VECTOR-VALUED PROCESSES, by H. Helson and D. Lowdenslager. [1960] [10]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)578] and National Science Foundation) Unclassified

Published in Proc. of the Fourth Berkeley Symposium on Mathematical Statistics and Probability, California U., Berkeley (June 20 - July 30, 1960), Berkeley, California U. Press, v. 2: 203-212, 1961.

The problem of multivariate processes is investigated. The multivariate prediction is stated as follows: Let y(t) (t = 0, ±1, [2,...) be a vector-valued stochastic process; that is, a random sequence of column vectors, whose components $y^j(t)$ (j = 1, 2,..., N) are complex random variables. The basic problem of prediction theory is to determine the linear combination of $\{y^k(t) | k = 1, \ldots, N, t < 0\}$ which is nearest $y^j(0)$ in the mean square or L^2 metric. The distance to be minimized is then $\|y^j(0) - \sum_{n>0} A_n^{jk} y^k(-n)\|$, where A_n^{jk} are arbitrary complex numbers.

2237

Princeton U. [Dept. of Mathematics] N. J.

ALMOST PERIODIC SOLUTIONS OF THE INHOMOGENEOUS WAVE EQUATION, by S. Bochner. [1960] [4]p. incl. refs. [AF 49(638)578] Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 46: 1233-1236, Sept. 1960.

The author's functions are defined on the entire infinite line $J = \{-\infty < t < \infty\}$. The following two theorems are stated by Luigi Amerio: Theorem 1: If in the differential $du(t)/dt = f(t)$, where u(t) and f(t) are functions from J to a separable Hilbert space H; if f(t) is almost periodic; and if the range of u(t) is bounded; then u(t) is almost periodic. Theorem 2: If the assumptions (α) - (δ) are satisfied, then the functions v'(t) and Bv(t) are almost periodic. The present aim is to state a third comprehensive theorem which subsumes these two. The following are assumptions for the new proposition: (1) There is given an equation $du(t)/dt = Cu(t) + f(t)$ in which u(t) and f(t) are functions from J to a separable Hilbert space H, and C is an (unbounded) closed linear operator from H to H defined on a dense linear subset of H; (2) there is given a sequence of closed linear subspaces $\{H_n\}$ of H, n = 1, 2, 3,..., any two mutually orthogonal, with $H = H_1 + H_2 + H_3 + \ldots$, such that on

each H_n the operator C is bounded (and thus also defined everywhere on it); (3) there is given a second closed linear operator A on H, again bounded on each H_n; (4) each H_n reduces the operators A and C, meaning that if $u \in H_n$, then $Au \in H_n$, $Cu \in H_n$; (5) on each H_n there are $A^*AC + C^*A^*A = 0$ where A^* is the adjoint of A, and C^* of C; (6) each H_n is finite dimensional, but nothing is stipulated about the size of the various dimensions; (7) f(t) lies in the domain of A for each t, and the functions f(t) and Af(t) are almost periodic; (8) u(t) lies in the domain of A for each t, and the functions u(t) and Au(t) are continuous and bounded; and (9) u(t) is a weak solution of equation (1) in the following sense. If ρ is an element of an H_n, then $d(u(t), \rho)/dt = (u(t), C^*\rho) + (f(t), \rho)$, the derivative existing. Theorem 3: If these 9 assumptions are satisfied, then the function Au(t) is almost periodic.

2238

Princeton U. [Dept. of Mathematics] N. J.

HARTOG'S THEOREM IN EUCLIDEAN SPACE AND A RELATED COUSIN THEOREM ON THE TORUS, by S. Bochner. [1960] [35]p. [AF 49(638)578]
Unclassified

Published in Contributions to Function Theory, Tata Inst. of Fundamental Research, Bombay, 1960, p. 79-113.

A theorem of Hartog reads: In the space of 2 or more complex variables if a bounded domain has a connected exterior, then any function which is defined and holomorphic in a neighborhood of the boundary of the domain can be continued analytically into the domain itself. An application of this theorem to a more comprehensive proposition set in real Euclidean E_n (Proc. Nat'l. Acad. Sci., v. 38: 227-230, 1952) is here continued. The problem reads as follows. Take a suitable elliptic operator with constant coefficients and of arbitrary order: $\Delta f = \sum_{p_1+\cdots+p_n \le 2h} a_{p_1 \cdots p_n} \frac{\partial^{p_1+\cdots+p_n} f}{\partial x_1^{p_1} \cdots \partial x_n^{p_n}}$, and some second (non-elliptic) operator with constant coefficients $\Lambda f = \sum_{q_1+\cdots+q_m \le m} b_{q_1 \cdots q_m} \frac{\partial^{q_1+\cdots+q_m} f}{\partial x_1^{q_1} \cdots \partial x_m^{q_m}}$, which acts only on a proper part of the variables, that is $m < n$. Now if f(x) is defined real-analytic in a neighborhood of the boundary, and if $\Delta f = 0$, $\Lambda f = 0$ then f can be continued analytically into the domain.

2239

Princeton U. [Dept. of Mathematics] N. J.

ANALYTIC SPACES. PART I, by H. Rossi. Feb. 1960 [85]p. (AFOSR-TN-60-283) (AF 49(638)692) AD 234814; PB 149649
Unclassified

A general survey of the local theory of analytic spaces is presented. Information is drawn from the theories of several complex variables, noetherian rings, and some field theory. The handling of coherent analytic sheaves is described, but no proofs of the deep theorems are given. An analytic space is briefly defined as a topological space X together with a subsheaf S of the sheaf of germs of continuous functions on X such that locally, X is a variety V, and S is the sheaf of V-holomorphic functions.

2240

Princeton U. [Dept. of Mathematics] N. J.

ANALYTIC SPACES. PART II, by H. Rossi. July 1960, 1v. (AFOSR-TR-60-100) (AF 49(638)692) AD 241307; PB 150048
Unclassified

Continuing the research of Part I (item no. 2239, Vol. IV) a proof of the normalization theorem is presented. The presentation is divided into preparatory material, necessary for understanding the proof, and the proof paper. The normalization theorem, that the normalization of an analytic space is again an analytic space, involves showing that X (an analytic space) can be locally embedded as a variety in some $\mathbb{C}^n$ so as to preserve the sheaf θ^*.

2241

Princeton U. [Dept. of Mathematics] N. J.

THE LOCAL MAXIMUM MODULUS PRINCIPLE, by H. Rossi. [1960] [11]p. (AF 49(638)692) Unclassified

Published in Ann. Math., v. 72: 1-11, July 1960.

The behavior of A on the set $S_A - \Gamma_A$ is studied. Let X be a compact Hausdorff. Let C(X) be the Banach algebra of continuous complex functions on X. Let A be any closed subalgebra of C(X) for which X is the space of maximal ideals. The Silov boundary $\Gamma(A)$ is the smallest closed set in X on which each f in A attains its maximum modulus. The main theorem proved is the following: If $x \in X-\Gamma(A)$ and U is a neighborhood of x, then for each f in A, $|f(x)|$ is not greater than the maximum of $|f|$ on the boundary of U. (Math. Rev. abstract in part)

2242

[Princeton U. Dept. of Mathematics, N. J.]

ON THE HOMOTOPY GROUPS OF THE CLASSICAL GROUPS, by B. Harris. [1960] [7]p. incl. refs. (AFOSR-688) (AF 49(638)919) AD 261111
Unclassified

Also published in Ann. Math., v. 74: 407-413, Sept. 1961.

Let SU(n), SO(n), Sp(n) denote the special unitary, special orthogonal, and symplectic groups. It is shown that the homotopy sequences of the fibrations $Sp(n) \to SU(2n) \to (SU(2n)/Sp(n))$, and $SO(2n+1) \to SU(2n+1) \to (SU(2n+1)/SO(2n+1))$ reduce to direct sum decompositions provided that 2-primary components are neglected. The C-isomorphism $\pi_i(Sp(n)) \approx \pi_i(SO(2n+1))$ is obtained. The 2-primary abelian groups: $\pi_i(SU(2n)) \approx \pi_i(Sp(n)) \oplus \pi_i(SU(2n)/Sp(n))$ and $\pi_i(SU(2n+1)) \approx \pi_i(SO(2n+1)) \oplus \pi_i(SU(2n+1)/SO(2n+1))$ which denote C, are proven by showing that although the above fibrations do not have a cross-section, there is a map which behaves like a cross-section in homology with coefficients any field of characteristic $\neq 2$. It is also shown that the direct sum decompositions of these two are simply the decompositions into the +1 and -1 eigenspaces of the map induced by the automorphism σ (of period two) on the homology groups of SU(m).

2243

Princeton U. [Dept. of Psychology] N. J.

SOME IMPLICATIONS OF TRACKING STUDIES FOR THEORETICAL PSYCHOLOGY, by J. M. Notterman. [1958] [9]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-381 and Office of Naval Research under Nonr-185819) Unclassified

Published in Proc. of Symposium on Air Force Human Engineering, Personnel, and Training Research; Nat'l. Research Council publ. no. 783, Washington, D. C. (Dec. 4-5, 1958), Washington, National Academy of Sciences, 1960, p. 107-115.

Tracking may be described as a task in which S is required to reduce the discrepancy between desired and actual conditions. The instantaneous value of this discrepancy is generally variable in time as a joint function of the environment's or the E's input, and S's output. The consequences of S's own behavior partially determines the value of ensuing discrepancies to which S again responds. Thus, a typical tracking situation is said to be one containing feedback. This behavioral homeostasis is related to physiological homeostasis only in the sense that, in both cases, self-regulatory action is taken to remove a discrepancy in a system. There is no forced or compelling nature in the notion of behavioral homeostasis as there is in physiological homeostasis. In this sense, the usual tracking experiment is but a laboratory or engineering special case, which serves to isolate and make obvious these characteristics of human or animal behavior referred to collectively here as behavioral homeostasis. If this approach is applicable to the detection and response problems posed by the real environment, as is the author's point of view, then theoretical psychology will be in debt to human engineering for the formulation of the problem and for the development of the techniques requisite for its solution.

2244

Princeton U. Dept. of Psychology, N. J.

DEMONSTRATION OF THE INFLUENCE OF STIMULUS AND RESPONSE CATEGORIES UPON DIFFERENCE LIMENS, by J. M. Notterman, G. A. Cicala, and D. E. Page. [1960] [2]p. incl. diagr. (AFOSR-TN-60-740) (AF 49(638)381) AD 239499 Unclassified

Also published in Science, v. 131: 983-984, Apr. 1, 1960.

Representative types of stimulus and response categories were used with the same subjects in determining the difference threshold for visual velocity discrimination. The observed interaction between these variables and difference limens was pronounced. (Contractor's abstract)

2245

Princeton U. Frick Chemical Lab., N. J.

MICROWAVE ABSORPTION AND MOLECULAR STRUCTURE IN LIQUIDS. XXXII. ANALYSIS OF THE RELAXATION TIMES OF n-ALKYL BROMIDES IN TERMS OF A DISTRIBUTION BETWEEN LIMITING VALUES, by K. Higasi, K. Bergmann, and C. P. Smyth. [1960] [4]p. incl. diagrs. table, refs. (AFOSR-TN-60-50) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)1331], National Science Foundation, and Office of Naval Research) AD 245264 Unclassified

Also published in Jour. Phys. Chem., v. 64: 880-883, July 1960.

The previously measured dielectric constants and losses of the n-alkyl bromides may be represented in terms of a distribution of relaxation times between 2 limiting values, which may be calculated from the relaxation time and the distribution parameter α obtained previously from the Cole-Cole arc plot. The lower limit is taken as the relaxation time of the rotational orientation of the CH_2Br group about its bond to the rest of the molecule, while the upper limit is the relaxation time of the largest orienting unit, usually the molecule as a whole. The numerical values obtained for the 2 limits, one small and increasing slowly with molecular size, and the other large and increasing rapidly with molecular size, are consistent with this physical picture of the relaxation process, indicating the approximate correctness of this distribution function. (Contractor's abstract)

2246

Princeton U. Frick Chemical Lab., N. J.

MICROWAVE ABSORPTION AND MOLECULAR STRUCTURE IN LIQUIDS. XXXIV. AN INTERFEROMETRIC METHOD FOR THE MEASUREMENT OF DIELECTRIC CONSTANT AND LOSS AT 4.3 MM WAVE LENGTH,

by W. E. Vaughan, K. Bergmann, and C. P. Smyth. [1960] [4]p. incl. diagrs. table. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18-(600)1331] and Office of Naval Research) AD 254987 Unclassified

Also published in Jour. Phys. Chem., v. 65: 94-97, Jan. 1961.

The theory and apparatus for an interferometric method for the measurement of the dielectric constant and loss of liquids at 4.3 mm wavelength are described. The probable error of the dielectric constant measurements is 1% except for extremely low loss materials, in which case the error increases as the loss decreases. The probable error of the loss measurements is 2%, increasing for both extremely high loss and extremely low loss. (Contractor's abstract)

2247

Princeton U. James Forrestal Research Center, N. J.

THE COLLISIONAL STABILIZATION OF EXCITED β-NAPHTHYLAMINE MOLECULES BY THE PARAFFIN HYDROCARBONS IN THE GAS PHASE, by B. Stevens. [1960] [8]p. incl. diagrs. tables, refs. (AF 33(038)-23976) Unclassified

Published in Molec. Phys., v. 3: 589-596, Nov. 1960.

The transfer of vibrational energy from molecules of β-naphthylamine excited by the mercury lines at 2804A and 2652A to the homologous series of paraffin hydrocarbons up to n-hexane was investigated in the gas phase at 180°C. Although the average amount of energy transferred collisionally increases with the complexity of the added gas by a factor of 5, the transfer efficiency expressed as an accommodation coefficient remains virtually unchanged. A transfer mechanism based upon the internal redistribution of vibrational energy within the collision complex is examined, in terms of which it is unnecessary to invoke vibration-vibration transfer except for pentane and hexane. The collision duration estimated on the basis of this model is well within an order of magnitude of that expected from collision diameters and relative velocities of the molecules concerned. (Contractor's abstract)

2248

Princeton U. James Forrestal Research Center, N. J.

IONIC DISORDER IN MANGANOUS OXIDE, by C. E. Birchenall. Dec. 1959 [7]p. incl. diagr. (Metallurgy rept. no. 21) (AFOSR-TN-60-62) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)533 and National Science Foundation) AD 232393; PB 145668 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 218: 1134-1135, Dec. 1960.

The dissociation pressure curve of nonstoichiometric manganous oxide determined by Davies and Richardson (Trans. Faraday Soc., v. 55: 604, 1959) was studied. An alternative interpretation is presented which is also based on appreciable intrinsic disorder interacting with the disorder resulting from the deviations from stoichiometric composition. The proposal is made that the dissociation pressure curve can be calculated reasonably well over the whole composition range studied without activity corrections by choosing appropriate equilibrium constant for the reactions $Mn^{2+} \rightleftharpoons Mn_i^{2+} + Mn_v''$ and $2Mn^{2+} + 1/2\ O_2\ (g) \rightleftharpoons O^{=} + Mn_v'' + 2Mn^{3+}$.

2249

Princeton U. James Forrestal Research Center, N. J.

SELF-DIFFUSION OF IRON AND SULFUR IN FERROUS SULFIDE, by R. H. Condit and C. E. Birchenall. Mar. 1960, 1v incl. diagrs. tables, refs. (Metallurgy rept. no. 24) (AF 49(638)533) AD 237371; PB 147772 Unclassified

Self-diffusion coefficients for iron and sulfur were measured by using radioactive tracers plated onto flat surfaces; penetration of these tracers below the surface was measured following a high-temperature diffusion anneal. The penetration profile was determined by the residual activity method with correction being made for that radiation originating below the surface. The iron self-diffusion appears to be primarily a vacancy mechanism, although in nearly stoichiometric compositions interstitial diffusion may play a role. The jumps of iron atoms between normally occupied iron sites aligned along the c-axis appear to be more frequent than jumps from normal sites not usually containing an iron atom; these jumps may be followed later by other jumps taking the atom into new normal sites. A set of measurements which were carried out at 298°C indicated that the antiferromagnetic ordering by itself does not depress the rate of diffusion, but the ordering of vacancies in sulfides near the composition, Fe_7S_8, does inhibit self-diffusion.

2250

Princeton U. James Forrestal Research Center, N. J.

OXIDATION OF IRON - CHROMIUM ALLOYS, by D. Lai, R. J. Borg and others. Feb. 29, 1960 [33]p. incl. illus. diagrs. refs. (Metallurgy rept. no. 22) (AFOSR-TN-60-387) (AF 49(638)533) AD 235785 Unclassified

Presented at Seventeenth annual Conf., Nat'l. Assoc. Corrosion Engineers, Buffalo, N. Y., Mar. 13-17, 1961.

Also published in Corrosion, v. 17: 109-116, July 1961.

The rates of oxidation of iron alloys containing 0.2 to 10% chromium have been measured from 750 to 1025°C. The nature of the products has been investigated by metallography, x-ray diffraction, and chemical analysis. At very low chromium concentrations there is a small increase in the oxidation rate compared with pure iron for short times, but for longer times the rate diminishes. The oxidation rate at a given temperature

diminishes with increasing chromium concentration. The rates are not given by any simple rate law, presumably because the products contain many pores and cracks. The accelerations in rate during an isothermal measurement do not occur at reproducible times or average thicknesses, which suggests that scale fracture plays an important role. A mechanism for scale embrittlement by chromium is proposed. The ways in which chromium might contribute to a reduced rate of oxidation of iron are discussed. (Contractor's abstract)

2251

Princeton U. James Forrestal Research Center, N. J.

OXIDATION OF METALS AND ALLOYS, by C. E. Birchenall. Final rept. Jan. 1, 1959-June 30, 1960 [17]p. incl. diagrs. tables, refs. (AFOSR-TR-60-96) (AF 49(638)533) AD 241462; PB 150138
Unclassified

Research was conducted on the following subjects: (1) self-diffusion in alpha iron (item no. 1764, Vol. III); (2) ionic disorder in manganous oxide (item no. 2248, Vol. IV); (3) oxidation of iron-chromium alloys (item no. 2250, Vol. IV); (4) self-diffusion or iron and sulfur in ferrous sulfide (item no. 2249, Vol. IV); (5) thermodynamics and phase relationships of some chromium sulfides; (6) diffusion over dimpled potential barriers; (7) diffusion in spinel ferrites; (8) diffusion of cobalt in alpha iron; (9) self-diffusion in delta iron; (10) diffusion along a single path and the effects of interstitial sites, in which ions are nearly as stable as in lattice sites, on the frequency factor in the rate equation for diffusion; and (11) self-diffusion of lead in lead sulfide. (See also item nos. 2252 and 2253, Vol. IV).

2252

Princeton U. [James Forrestal Research Center] N. J.

SELF-DIFFUSION OF IRON IN NICKEL FERRITE, by R. H. Condit, M. J. Brabers, and C. E. Birchenall. [1959] [1]p. incl. diagrs. (AFOSR-3579) [AF 49(638)-533] AD 612329 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 218: 768, Aug. 1960.

The hypothesis that nickel substituting for iron in magnetite might decrease the rate of spinel growth by reducing the iron mobility is tested. Results show that nickel plays the following roles in reducing the oxidation rate of iron-nickel alloys: (1) reduces progressively the stability range of wüstite, and of the iron-nickel spinel phase in terms of the variation in cation to anion ratio; and (2) reduces the cation mobility in the spinel phase which is the faster growing phase in the absence of wüstite.

2253

Princeton U. [James Forrestal Research Center] N. J.

THE MECHANISMS OF DIFFUSION IN SOLIDS, by C. E. Birchenall. [1960] [14]p. incl. diagr. tables, refs. [AF 49(638)533] Unclassified

Published in Reactivity of Solids; Proc. Fourth Internat'l. Symposium, Amsterdam (The Netherlands) (May 30-June 4, 1960), Amsterdam, Elsevier, 1961, p. 24-37,

The criteria which are employed in the determination of diffusion mechanisms are reviewed and some examples of their applications to a variety of substances are given, including metals, covalent semiconductors, alkali halides, oxides and sulfides. The suggested criteria to be considered in making an acceptable choice of transport mechanism are: (1) Diffusion occurs predominantly by that mechanism which requires the lowest activation energy in the particular structure. (2) Diffusion occurs by the motion of a particular point defect if it is present at equilibrium in appreciable concentration. (3) Displacements of inert markers indicate defect diffusion. (4) A measured numerical value of the correlation coefficient may limit the choice of mechanism. (5) Comparison may be made of measured frequency factors with theoretical values, which are supported in a general way by other cases for which independent evidence of mechanism exists. (6) In anisotropic crystals it is sometimes possible to show the need for 2 distinct types of jump, without necessarily limiting the jump mechanism. (7) Comparison of diffusivities calculated from Kuczynski's theory of neck growth with directly measured self-diffusion coefficients indicates predominantly a ring mechanism for diffusion if the latter is considerably greater than the former.

2254

Princeton U. Palmer Physical Lab., N. J.

MU CAPTURE, BETA DECAY, AND PI-MESON DECAY, by M. L. Goldberger. [1959] [5]p. incl. diagrs. [AF 49(638)304] Unclassified

Published in Rev. Modern Phys., v. 31: 797-801, July 1959.

The structure of the matrix-elements for μ-capture, β-decay and π-meson decay is analyzed using dispersion techniques (spectral representations). The principal results are: (1) the demonstration of an effective pseudoscalar coupling in μ-capture; (2) an estimate of weak magnetism, and (3) an explanation of the π-decay lifetime on the assumption that transitions via nucleon-antinucleon pairs are of greatest importance.

2255

Princeton U. Palmer Physical Lab., N. J.

PION-PION SCATTERING AND $K^{\pm} \rightarrow 3\pi$ DECAY, by N. N. Khuri and S. B. Treiman. [1960] [21]p. (AFOSR-TN-60-360) (AF 49(638)304) Unclassified

Also published in Phys. Rev., v. 119: 1115-1121, Aug. 1, 1960.

The effect of final state pion-pion interactions on the spectrum of $K^{\pm} \rightarrow 3\pi$ decay is studied by dispersion relation methods. In the approximations adopted we are led to a set of linear integral equations for the amplitudes of the $K^{\pm} \rightarrow 3\pi$ decay. The kernels in these equations depend on the pion-pion S-wave scattering amplitudes. An approximate solution for these equations is obtained by iteration and the departures from a purely statistical spectrum for the decay are related to pion-pion S-wave scattering. The latter in turn is assumed to be well represented with a scattering length structure. The $K^{\pm} \rightarrow 3\pi$ spectrum then is parametrized by two quantities, the T = 0 and T = 2 pion-pion S-wave scattering lengths, a_0 and a_2. Such experimental results as presently exist indicate that $a_2 - a_0$ is positive and that roughly $a_2 - a_0 \approx 0.7$, in units of the pion Compton wavelength.

2256

Princeton U. [Palmer Physical Lab.] N. J.

BOUND STATES AND DISPERSION RELATIONS, by R. Blankenbecler and L. F. Cook, Jr. [1960] [26]p. incl. diagrs. refs. (AFOSR-TN-60-361) [AF 49(638)-304] Unclassified

Also published in Phys. Rev., v. 119: 1745-1752, Sept. 1, 1960.

A vertex closely related to the Bethe-Salpeter amplitude is discussed in the one meson exchange approximation by dispersion theory methods. Both scalar and spinor cases are treated. The relations between anomalous thresholds and the Schroedinger equation are discussed in some detail. It is shown that dispersion methods can be used to determine bound state parameters. An estimate is made of the asymptotic (D-S) ratio for the deuteron. (Contractor's abstract)

2257

Princeton U. Palmer Physical Lab., N. J.

ELASTIC NEUTRON-DEUTERON SCATTERING, by R. Blankenbecler, M. L. Goldberger, and F. R. Halpern. [1959] 30p. incl. refs. (AFOSR-TN-60-362) (AF 49-(638)304) Unclassified

Also published in Nuclear Phys., v. 12: 629-646, Sept. 1959.

The process of elastic neutron-deuteron scattering is discussed from the standpoint of dispersion theory. Aside from the appearance of anomalous thresholds, there seems to be no difficulties in principle, although no derivation of the relations is attempted. Certain features of the process, such as the pick-up peak in the backward direction, appear quite neatly and the general occurrence of such phenomena is discussed. The theory is developed for the general case, but our only application is to forward scattering at low energies where phase shift analyses are available. The agreement with experiment is quite good. (Contractor's abstract)

2258

Princeton U. Palmer Physical Lab., N. J.

THEORY OF LOW ENERGY NUCLEON-NUCLEON SCATTERING, by M. L. Goldberger, M. T. Grisaru and others. [1960] [86]p. incl. diagrs. table, refs. (AFOSR-TN-60-829) (AF 49(638)304) Unclassified

Also published in Phys. Rev., v. 120: 2250-2276, Dec. 15, 1960.

The two-nucleon problem is discussed from the standpoint of the double dispersion relations. The analytic structure of partial wave amplitudes is completely analyzed. This is greatly facilitated by the use of the Jacob-Wick helicity amplitudes. The program of generating a set of dynamical equations by use of the unitarity condition is carried out. In the present approximation only one- and two-pion exchanges are considered; the resulting system of equations should be adequate for energies below about 170 mev. The problem of computing the deuteron parameters is discussed. The general structure of the more complicated nucleon-antinucleon system is briefly discussed.

2259

Princeton U. Palmer Physical Lab., N. J.

LONGER RANGE VIEW OF NUCLEAR ENERGY, by A. M. Weinberg and E. P. Wigner. [1960] [4]p. incl. tables. (AFOSR-J787) [AF 49(638)304] AD 413457 Unclassified

Also published in Bull. Atomic Scientists, v. 16: 400-403, Dec. 1960.

The chief objective of this report is to determine whether reactor research ought to have as its primary aim the development of burners or of breeders. The analysis suggests that more emphasis should be placed on (1) the search for a practical breeder, (2) the improvement of the conservation ratio of burners, and (3) a solution to the long-term waste disposal problem.

2260

Princeton U. [Palmer Physical Lab.] N. J.

QUANTUM FIELD THEORY AND ANALYTIC FUNCTIONS OF SEVERAL COMPLEX VARIABLES, by A. S. Wightman. [1958] [53]p. incl. refs. (AFOSR-J793) [AF 49(638)304] AD 413380 Unclassified

Also published in Jour. Indian Math. Soc., v. 24: 625-677, Dec. 1960.

A systematic development of non-trivial problems in functional analysis and analytic function theory is presented. Topics covered are: (1) the analyticity of

vacuum expectation values in the extended tube, and (2) consequences of local commutativity and weak local commutativity.

2261

Princeton U. [Palmer Physical Lab.] N. J.

COORDINATE INVARIANCE AND ENERGY EXPRESSIONS IN GENERAL RELATIVITY, by R. Arnowitt, S. Deser, and C. W. Misner. [1960] [10]p. (AFOSR-J806) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)304] and National Science Foundation) Unclassified

Also published in Phys. Rev., v. 122: 997-1006, May 1, 1961.

The invariance of various definitions proposed for the energy and momentum of the gravitational field is examined. It is found that none of the expressions giving the energy as a 2-dimensional surface integral are invariant within a class of frames containing coordinate waves. In such a frame they are ambiguous, since their value depends on the location of the surface at infinity. If the prescription of space-time averaging of the integrals is introduced, the definitions of Landau-Lifshitz and Papapetrou-Gupta yield (equal) coordinate-invariant results. However, the definitions of Einstein, Møller, and Dirac become unambiguous, but not invariant. The averaged Landau-Lifshitz and Papapetrou-Gupta expressions are then shown to give the correct physical energy-momentum. This latter definition yields that inertial energy for a gravitational system would be measured by a non-gravitational apparatus interacting with it. It is further shown that the energy-momentum may be invariantly calculated from the asymptotic form of the metric field at a fixed time. (Contractor's abstract)

2262

Princeton U. Palmer Physical Lab., N. J.

GEOMETRODYNAMICS AND THE PROBLEM OF MOTION, by J. A. Wheeler. [1960] [18]p. incl. tables, refs. (AFOSR-J815) [AF 49(638)304] AD 413709 Unclassified

Also published in Rev. Modern Phys., v. 33: 63-78, Jan. 1961.

Two models of masses are considered for the insight they throw on the validity of the usual derivations of the equations of motion. One, Schwarzschild-like concentrations of mass-energy, evolve within a finite proper time into a (1) singular state beyond which no purely classical analysis of their further development in time is possible. The motion of the other model, a geon, can be described in terms of the concept of equations of motion only when that description is corrected for effects which are neglected in the usual derivation of such equations; (2) slow dissipation of mass by leakage; (3) self-acceleration by one-sided emission of leakage radiation; (4) changes in structure or disintegration induced by weak fields arising from the environment; (5) departure from anything resembling a δ-function structure or from a structure all of whose moments can be calculated by simple volume integration. It is concluded that all 5 effects must be present in any really correct classical derivation of the equations of motion from the classical field equations.

2263

Princeton U. Palmer Physical Lab., N. J.

MEASUREMENT OF THE CURVATURE IN A TWO-DIMENSIONAL UNIVERSE, by E. P. Wigner. [1960] [1]p. (AFOSR-J816) [AF 49(638)304] AD 409177 Unclassified

Also published in Phys. Rev., v. 120: 643, Oct. 15, 1960.

The usual definition of the curvature of space involves concepts, such as the measurement of the metric tensor or parallel displacement, which have no direct physical counterpart. The question of obtaining the curvature of a two-dimensional space by means of measurements which are possible, at least in principle, is reviewed and a formula given before is corrected and generalized. (Contractor's abstract)

2264

Princeton U. Palmer Physical Lab., N. J.

GEOMETRY OF LIGHT PATHS BETWEEN TWO MATERIAL BODIES, by E. P. Wigner. [1960] [5]p. incl. diagrs. (AFOSR-J819) (AF 49(638)304) AD 413680 Unclassified

Also published in Jour. Math. Phys., v. 2: 207-211, Mar.-Apr. 1961.

The pattern of light signals, which was proposed before for the measurement of the curvature, is investigated in a 2-dimensional manifold of constant curvature (deSitter space). The pattern consists of light signals between 2 freely moving bodies, each signal being emitted when the signal from the other body arrives. It is shown that the coordinates of the arrivals (or emissions) of the light signals can be obtained from the coordinates of the emission of the first signal by means of projective transformations which are iterates of a single transformation. The same applies to the proper times at which these signals are received. (Contractor's abstract)

2265

Princeton U. Palmer Physical Lab., N. J.

WEAK GLOBAL SYMMETRY, by S. B. Treiman. [1960] [9]p. incl. refs. [AF 49(638)304] Unclassified

Published in Nuovo Cimento, Series X, v. 15: 916-924, Mar. 16, 1960.

The Feynman, Gell-Mann model of weak interactions is modified by the introduction of neutral currents, both

of the strangeness preserving (J) and strangeness changing (S) variety. The various currents, neutral and charged, are chosen and coupled in such a manner as to guarantee the $|\Delta T| = 1/2$ section rule. The J currents, charged and neutral, are taken together to form an isotopic vector. The charged S currents are taken to satisfy $\Delta S/\Delta Q = +1$. These conditions automatically impose on the S currents the property that they transform like the components of an isotopic spinor. The arbitrariness in the currents which remains at this stage is now removed by a definite choice, patterned after and meant to exploit Gell-Mann's model of global symmetry for strong baryon-pion interactions. Certain fairly definite and verifiable predictions can be made concerning leptonic decay of hyperons: the protons in $\Sigma^+ \rightarrow p + \pi^\circ$ decay should be polarized in an opposite sense from those produced in $\Lambda^\circ \rightarrow p + \pi$-decay; and Ξ and Λ decays should show the same polarization properties. (Contractor's abstract)

2266

Princeton U. Palmer Physical Lab., N. J.

ON ASYMPTOTIC BEHAVIOR OF VACUUM EXPECTATION VALUES AT LARGE SPACE-LIKE SEPARATION, by H. Araki. [1960] [15]p. incl. refs. [AF 49(638)304] Unclassified

Published in Ann. Phys., v. 11: 260-274, Oct. 1960.

The asymptotic behavior of truncated vacuum expectation values at large space-like separation is studied. Truncated vacuum expectation values are vacuum expectation values of products of field operators where the vacuum structure is subtracted out. It is shown under conventional assumptions of relativistic quantum field theory that the truncated vacuum expectation values at equal time tend to zero exponentially as the largest distance R of points tends to infinity with an exponent mR where m is the lowest mass and is assumed positive. It is also shown that the truncated vacuum expectation values tend to zero in an averaged sense faster than any power of R if the points are divided into two groups and separated by large space-like distance R where the points need not lie on a common space-like hypersurface. (Contractor's abstract)

2267

Princeton U. [Palmer Physical Lab.] N. J.

ANOMALOUS THRESHOLDS IN DISPERSION THEORY - I, by R. Blankenbecler and Y. Nambu. [1960] [13]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)304] and Atomic Energy Commission) Unclassified

Published in Nuovo Cimento, Series X, v. 18: 595-607, Nov. 1, 1960.

The form factor of a particle in the so-called anomalous case (loosely bound system) is studied from the view point of: (1) description in terms of a Schrödinger-type wave function; (2) perturbation theory; and (3) dispersion theory. A prescription is given on how to calculate the absorptive part of a dispersion relation in the correct Riemann sheet. (Contractor's abstract)

2268

Princeton U. Palmer Physical Lab., N. J.

APPLICATION OF DISPERSION RELATIONS TO NUCLEON-NUCLEON SCATTERING: THE TWO-PION CONTRIBUTION, by M. L. Goldberger and R. Oehme. [1959] [18]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)304 and Atomic Energy Commission) Unclassified

Published in Ann. Phys., v. 10: 153-170, 1960.

The two-pion contribution to the amplitude for the nucleon-nucleon scattering is computed in terms of the invariant amplitudes which characterize the four-body Green's function of the pion nucleon system. The dependence of this contribution upon the momentum is completely exhibited. A general method, describing the derivation of symmetry properties for the invariant coefficients in the expansion of the scattering amplitude in spinor space, is presented. (Contractor's abstract)

2269

Princeton U. Palmer Physical Lab., N. J.

INITIAL VALUE DATA FOR POISSON BRACKETS IN GENERAL RELATIVITY, by J. G. Fletcher. [1960] [12]p. [AF 49(638)304] Unclassified

Published in Ann. Phys., v. 12: 283-294, Feb. 1961.

As a preliminary step toward constructing the commutators of a quantized theory of general relativity, Poisson brackets for the classical theory are found on an initial-like surface. These can then be extended over all space-time by solving the equations of motion. The theoretical structure used to find the brackets is an extension of the formalism of Schwinger. The brackets obtained are determined only up to a gauge transformation. (Contractor's abstract)

2270

Princeton U. Palmer Physical Lab., N. J.

CONSTRUCTION OF UNITARY SCATTERING AMPLITUDES, by R. Blankenbecler. [Dec. 1960] [10]p. incl. diagr. refs. [AF 49(638)304] Unclassified

Published in Phys. Rev., v. 122: 983-992, May 1, 1961.

A general linear technique is discussed which constructs unitary scattering amplitudes without expanding in partial waves and in the presence of inelastic channels. Two- and three-particle intermediate states are discussed explicitly, but the method can be extended directly to any finite number of particles. A new approximation technique suggested by this formalism is applied to electroproduction of pions from pions and pion-K-meson

scattering. A form of the impulse approximation is derived for both the coupled form factor and the coupled scattering amplitude problems. The nucleon and deuteron form factor system is briefly discussed. Finally, a model field theory which contains three-particle intermediate states is formulated and solved by the linear technique for purely pedagogical reasons. (Contractor's abstract)

2271

Puerto Rico U. [Dept. of Electrical Engineering] Mayaguez.

PECULIARITIES AND SEASONAL VARIATIONS OF TRANSEQUATORIAL BACKSCATTER ECHOES AS OBSERVED AT MAYAGUEZ, PUERTO RICO, by B. Dueño. [1960] [8]p. incl. illus. diagrs. (AFOSR-TN-60-949) (AF 49(638)172) AD 245918 Unclassified

Also published in Jour. Geophys. Research, v. 65: 1691-1698, June 1960.

As a result of a backscatter experiment on 21.6, 40.68, and 49.68 mc/sec, it has been observed that long-range transequatorial echoes, which are most prevalent during the equinoxial periods, also exhibit a minimum of transequatorial activity during the solstitial periods June, July and December, January. The mechanism for the production of long-range transequatorial echoes (LRTE) is not well understood. By comparing the data with National Bureau of Standards propagation predictions, it is proposed that the echoes result from the combined action of the evening equatorial bulge and sizeable concentrations in electron density at the north and south edges of the bulge. The large concentration of electron density in the north edge occurs over Bogotá, Colombia and is easily observable in the late evening hours on the 40- and 50-mc/sec channels at slant ranges slightly under 4000 km. From experimental evidence it is deduced that the angle of arrival of LRTE is quite low and that the propagation mode is such that the wave stays a short fraction of its total path in the ionosphere. It is also anticipated that a 60-mc/sec backscatter radar would see LRTE activity for a very small fraction of time. At this point it is well to concede that backscatter results are on the pessimistic side if compared with ordinary 1-way transmissions used in communication circuits. (Contractor's abstract)

2272

Puerto Rico U. Dept. of Electrical Engineering, Mayaguez.

SPORADIC E AS OBSERVED FROM MAYAGUEZ, PUERTO RICO, BY BACKSCATTER SOUNDERS, by B. Dueño. Jan. 1958-May 1960 [22]p. incl. diagrs. (Research Rept. no. 3) (AFOSR-35) (AF 49(638)172) AD 252696 Unclassified

Also published in Ionospheric Sporadic E., London, Pergamon Press, Ltd., v. 2: 110-122, 1962.

Sporadic-E activity was studied in the Caribbean-Atlantic area by means of a multichannel backscatter sounder, from Jan. 1958 to May 1960. It was found that E_s (sporadic E) activity increases rapidly from May to June with the maxima occurring during June and July. During December and part of January there was minor activity. More E_s was observed around 1730 hr, AST, and in the southern direction than at any other time and direction. Those E_s clouds that were found to drift had a mean velocity of the order of 500 km/hr with a prevailing direction to the southeast. (Contractor's abstract)

2273

Purdue Research Foundation, Lafayette, Ind.

ONE-DIMENSIONAL MONOTONE RETRACTS, by A. Lauria and C. J. Neugebauer. July 1960, 45p. incl. refs. (Technical note no. 23) (AFOSR-TN-60-758) (AF 18(600)1484) AD 244695 Unclassified

The problem of classifying all regular curves which are monotone retracts of a Peano space P is considered. Unless $r(P) < \infty$, the degree of multicoherence of P, this class of retracts may be vacuous. If $r(P) = n$, $n < \infty$, the class of all regular curves R, $r(R) = n$, which are monotone retracts of P is characterized. Regular curves from the point of view of their degree of multicoherence are studied. A characterization of unicoherent Peano spaces due to G. T. Whyburn (Bull. Amer. Math. Soc., v. 52: 109-112, 1956) is extended to multicoherent Peano spaces. (Contractor's abstract)

2274

Purdue Research Foundation, Lafayette, Ind.

ANALYTICAL THEORY OF CONTINUOUS TRANSFORMATIONS. Final rept. Sept. 1, 1955-Aug. 31, 1960 [9]p. incl. refs. (Technical status rept. no. 11) (AFOSR-TR-60-146) (AF 18(600)1484) Unclassified

The analytic and topological properties of parametric surfaces have been investigated under the sole hypothesis that they be continuous and have finite area. Such properties have proved to be essential in questions of analysis, in particular in the calculus of variations and its applications. Also included in this paper are listings of technical reports resulting from the contract and papers published in the literature. (Contractor's abstract)

2275

Purdue Research Foundation, Lafayette, Ind.

A MINIATURE THEORY OF LEBESQUE AREA, by E. Silverman. [1960] [7]p. incl. refs. (AF 18(600)1484) Unclassified

Published in Amer. Math. Monthly, v. 67: 424-430, May 1960.

The Weierstrass line integral I (f, x) for positive convex integrand f and rectifiable parametric curves x = x (t),

$0 \le t \le 1$, $x(t) \in E_n$, has been often treated after K. Menger as a generalized length. It is shown how the main properties of $I(f, x)$ can be elegantly obtained - for positive convex f- by the use of the same process which has been used for area in recent years. In particular, a new proof of the property of lower semicontinuity is obtained.

2276

Purdue [Research Foundation] Lafayette, Ind.

A NOTE ON TOEPLITZ MATRICES AND UNITARY EQUIVALENCE, by C. R. Putnam. [1960] 4p. (AFOSR-TN-60-28) (AF 18(603)139) AD 233511; PB 146362 Unclassified

Also published in Boll. Unione Matem. Ital., v. 15: 6-9, 1960.

A generalization is obtained for a condition assuring the unitary equivalence of a Toeplitz matrix (c_{j-k}) to a certain function of the matrix belonging to the quadratic form $2\sum_1^\infty x_n x_{n+1}$. Let $\{c_n\}$ be a sequence of complex numbers satisfying $c_{-n} = \bar{c}_n$ and $\sum_1^\infty |c_n|^2 < \infty$. A relaxation of the restriction c_n are real is used to establish an equivalence relation similar to $T = UFU^*$ where $T = (c_{j-k})$, $F = (\int_0^\infty f(\theta)\, d\rho_{jk}(\theta))$ and U is unitary. The relation is developed between T and a matrix G closely related to F, where $G = (\int_0^\pi g(\theta)\, d\rho_{jk}(\theta)$, $g(\theta) \sim \sum_{-\infty}^{\infty} a_n e^{in\theta} = a_0 + 2\sum_1^\infty a_n \cos n\theta$.

2277

Purdue Research Foundation, Lafayette, Ind.

GROUP COMMUTATORS OF BOUNDED OPERATORS IN HILBERT SPACES, by C. R. Putnam. Oct. 1960, 5p. (Technical note no. 12) (AFOSR-TN-60-718) (AF 18(603)139) AD 245344; PB 152761 Unclassified

Various conditions on operators A and B which make $AD = BA$ where $D = ABA^{-1}B^{-1}$ implies $AB = BA$ are discussed. It is known that if in addition to the above conditions, A and B are finite-dimensional unitary matrices and if the spectrum of B is contained in some open semicircle on the circle $|z| = 1$, then necessarily $D = I$, that is $AB = BA$. Generalizations of this result are obtained. In particular it is shown that the restriction that A and B are finite matrices is removed. When B is unitary, the above assumption concerning sp(B) is equivalent to the condition that 0 fails to belong to the set W(B).

2278

Purdue Research Foundation, Lafayette, Ind.

A NOTE ON THE SPECTRA OF GROUP COMMUTATORS, by C. R. Putnam. Oct. 1960, 5p. (Technical note no. 13) (AFOSR-TN-60-744) (AF 18(603)139) AD 245343 Unclassified

Results on the location of the spectrum of $ABA^{-1}B^{-1}$ in case A commutes with AB - BA are obtained. (Contractor's abstract)

2279

Purdue Research Foundation, Lafayette, Ind.

COMMUTATORS, PERTURBATIONS, AND UNITARY SPECTRA, by C. R. Putnam. June 1961, 25p. incl. refs. (Technical note no. 14) (AFOSR-TN-60-1450) (AF 18(603)139) AD 259085; PB 259085 Unclassified

Also published in Acta Math., v. 106: 215-232, 1961.

Let A and B denote linear operators, bounded or unbounded, on a Hilbert space H of elements x. Let $\|x\| = (x, x)^{1/2}$ and put $\|A\| = \sup \|Ax\|$ where $\|x\| = 1$. If A and B are bounded and if C denotes the commutator of A and B, (1) $C = AB - BA$, then it is well known that (2) $\|C\| \le 2\|A\|\,\|B\|$, and that the inequality cannot be improved by replacing the 2 by $2 - \epsilon$ with $\epsilon > 0$. Simple examples with finite matrices $A \neq 0$, $B \neq 0$ and A, iB (hence also C) even self-adjoint show that the equality of (2) may hold. Part I concerns an improvement of (2) when B is bounded but otherwise arbitrary, A and C are bounded and self-adjoint and C is non-negative. In Part II a related problem is considered concerning perturbations of a self-adjoint operator A. In Part III applications are given of the results of Part II to semi-normal operators, Laurent matrices, measure preserving transformations, and to what correspond to certain operators occurring in scattering theory in quantum mechanics.

2280

Purdue [Research Foundation] Lafayette, Ind.

ON COMMUTATORS AND JACOBI MATRICES, by C. R. Putnam. [1955] [5]p. (AFOSR-3255) (Sponsored jointly by [Air Force Office of Scientific Research under AF 18-(603)139] and National Science Foundation) AD 428406 Unclassified

Also published in Proc. Amer. Math. Soc., v. 7: 1026-1030, Dec. 1956.

Let A and B be bounded linear operators on a Hilbert space H and let A be normal. Let $C = AB - BA$ be the commutator of A and B and let W be the set in the complex plane consisting of the closure of the convex set (Cx, x), $x \in H$. Conditions are given on A which insure that 0 be an interior point of W, "interior" meaning interior to the segment W if W is one-dimensional, $0 = W$ if W is a single point and interior in the usual sense if W is two-dimensional. Let A have the spectral

resolution $A = \int_{\mathcal{L}} z dK(z)$, K the spectral measure. Then if $\int_S dK = I$ where S is a set measurable K which for any $\epsilon > 0$ can be covered by a sequence of pairwise disjoint measurable sets the sum of whose diameters is less than ϵ, then 0 is interior to W. Simpler conditions will suffice if A is self-adjoint or unitary. In particular, if A has a pure point spectrum then 0 is interior to W. It is shown as a corollary that a large class of Jacobi matrices cannot have a pure point spectrum. (Math. Rev. abstract)

2281

Purdue [Research Foundation] Lafayette, Ind.

CONTINUOUS SPECTRA AND UNITARY EQUIVALENCE, by C. R. Putnam. [1956] [3]p. (AFOSR-3256) (Sponsored jointly by [Air Force Office of Scientific Research under AF 18(603)139] and National Science Foundation) Unclassified

Also published in Pacific Jour. Math., v. 7: 993-995, 1957.

Let $p(t) > 0$ and $f(t)$ be real-valued functions on $0 \leq t < \infty$, the latter being continuous, and let λ be a real parameter. Suppose that the differential equation $(px^1)^1 + (\lambda + f)x = 0$ is of the limit point type at $t = +\infty$, and consider the boundary value problem B_α given by the above equation and the boundary condition $x(0) \cos \alpha + x^1(0) \sin \alpha = 0$, where $0 \leq \alpha < \pi$. Let S_α be the spectrum, and H_α the self-adjoint operator belonging to B_α. Suppose there is a fixed couple $\alpha\ \beta$ $(0 \leq \alpha < \beta < \pi)$ such that H_α and H_β have a purely continuous spectrum, which by a result of H. Weyl implies that their spectra are identical. The object of the paper is to show that then H_α and H_β are unitarily equivalent provided that the following two additional conditions are satisfied: (1) neither spectrum covers the whole infinite line, and (2) the monotone nondecreasing function of λ which determines the continuous spectrum is absolutely continuous for H_α and H_β. The proof consists in showing that the difference $H_\beta^{-1} - H_\alpha^{-1}$ satisfies sufficient conditions for unitary equivalence given by Rosenblum (Pacific Math. Jour., v. 7: 997-1010, 1957). Finally the result is illustrated by discussing the case where $f(t) \equiv 0$. (Math Rev. abstract)

2282

[Purdue Research Foundation] Lafayette, Ind.

ON THE SPECTRA OF GROUP COMMUTATORS, by C. R. Putnam. [1960] [5]p. (AFOSR-3257) (AF 18-(603)139) AD 428347 Unclassified

Also published in Boll. Unione Matem. Ital., v. 15: 379-383, 1960.

Results are obtained on the location of the spectrum of $ABA^{-1}B^1$ in case A commutes with AB-BA. All operators A, B,... are considered to be bounded (linear) on a Hilbert space and sp(A) denotes the spectrum of A. It has been shown that if AC = CA, where C denotes the commutator C = AB - BA, then sp(C) consists of 0 only. In case A^{-1} and B^{-1} exist (that is, if 0 fails to belong to sp(A) and sp(B)) the commutator D can be considered as defined by $D = ABA^{-1}B^{-1}$ and the question is raised as to whether AC = CA implies spD = 1 only. It has been shown that the answer is affirmative in case A has a logarithm commuting with every operator which commutes with A, that is, if $A = e^E$, AX = XA → EX = XE (X arbitrary). Some facts are ascertained concerning the set sp(D) if AC = CA and something less than the "commuting logarithm" case are assumed.

2283

Purdue U. Dept. of Chemistry, Lafayette, Ind.

THE STOICHIOMETRY AND RESISTIVITY OF PrO_x, by A. F. Clifford and P. A. Faeth. Nov. 11, 1960 [14]p. incl. diagrs. table. (AFOSR-TN-60-1455) (AF 18(603)-45) PB 154076 Unclassified

Also published in Rare Earth Research; a Seminar, Lake Arrowhead, Calif. (Oct. 1960), New York, MacMillan Co., 1961, p. 105-112. (AFOSR-1798)

Praseodymium oxide (PrO_x) is unusual in that it has several stable intermediate compositions between $PrO_{1.50}$ and $PrO_{2.00}$. In an effort to obtain a further indication of the phase transition, without resorting to high temperature x-ray experiments, a thermoelectric power (TEP) cell was constructed for the measurement of TEP and resistivity. Several important features of the log R (R = resistance vs 1/T plot worth noting are: (1) the resistance at about 925° C appears to be a pivet point, which is interpreted as the transition temperature; and (2) the vacuum isobars show several linear regions with breaks at significant temperatures. Either of two interpretations may be put upon these data: (a) that changes in the Pr_2O_3 structure dictate the temperature at which changes of composition may occur in higher oxides; or (b) that despite the fact that the system was maintained at about 10^{-5} mm pressure by continuous pumping, there was still enough oxygen available to change the surface composition at the appropriate temperatures, giving rise to changes in resistance.

2284

[Purdue U. Dept. of Chemistry] Lafayette, Ind.

INFRA-RED SPECTRUM OF PRASEODYMIUM NITRITE, by F. Vratny, M. Tsai, and F. Gugliotta. [1960] [3]p. incl. diagrs. (AFOSR-260) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)45 and [Massachusetts Inst. of Tech.]) Unclassified

Also published in Nature, v. 188: 484-485, Nov. 5, 1960.

The spectra of the powdered metal nitrites were obtained

on a double-beam Perkin Elmer model 21 spectrometer using sodium chloride optics. The spectra of the simple nitrites: sodium, potassium, silver and barium are rather straight-forward. The band at about 830 cm^{-1} represents the ν_2 bending mode, the band at about 1,250 cm^{-1} is the ν_1 symmetric stretching, and the band at about 1,360 cm^{-1} is the ν_2 asymmetric stretching. The spectrum of praseodymium nitrite is more complex. The magnitude of splitting that occurs is greater than the field splitting observed in metal nitrates. The splitting produced in praseodymium nitrite strongly suggests a bridge structure similar to that of $Co(NH_3)_2(NO)_3$ in either cis or trans configuration.

2285

Purdue U. [Dept. of Chemistry] Lafayette, Ind.

THE USE OF FLUOROCARBON OILS AND LUBRICANTS WITH NITROGEN DIOXIDE, by F. Vratny and J. M. Honig. [1960] [1]p. (AFOSR-261) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)45, Massachusetts Inst. of Tech., and National Science Foundation under NSF-G5122) Unclassified

Also published in Jour. Chem. Education, v. 37: 624, Dec. 1960.

The use of fluorocarbon oils and greases for both manometering and lubrication of stopcocks is discussed. These oils are fluorinated hydrocarbons of the general formula $(CF_2CFCl)_x$ and an average molecular weight in the 775-950 range. Their pour points range from -15° to 18°C. Their densities are about 1.9 gm/cc and their vapor pressures range from 2.5 to 1.2×10^{-3} mm of Hg at 100°F. The lighter weight oils can be employed for most purposes. Several advantages are inherent in the use of Fluorolube HO. Among these is the extreme inertness to nitrogen dioxide. Secondly, because of its density, it is about 7 times more sensitive than mercury. Thirdly, its viscosity cushions extremely sudden surges in pressure and at the same time it is fully capable of registering a change of 400 mm of oil within 1/2 min. Fluorocarbon lubricated stopcocks do not exhibit any chemical attack and exhibit channeling only as the nitrogen dioxide pressure approaches one atmosphere. For nitrogen dioxide pressure in the vicinity of one atmosphere, it has been found more practical to employ Teflon stopcocks.

2286

Purdue U. Dept. of Chemistry, Lafayette, Ind.

HYSTERESIS EFFECTS IN PRASEODYMIUM OXIDE (Abstract), by A. F. Clifford and P. A. Faeth. [1960] [1]p. [AF 18(603)45] Unclassified

Presented at meeting of the Amer. Chem. Soc., New York, Sept. 11-16, 1960.

Abstract published in 137th meeting of the Amer. Chem. Soc., Abstracts of Papers, 1960, p. 50-S.

The composition-pressure diagram of the Pr-O system has been studied between 10^{-5} and 150 mm oxygen pressure using a quartz beam microbalance. In the temperature range, 400 - 1000°C, the compositions $PrO_{1.50}$, $PrO_{1.71}$, $PrO_{1.78}$, $PrO_{1.80}$, and $PrO_{1.83}$ are stable. The transition from one to another of the above compositions shows hysteresis properties. The isotherms between 400°C and 500°C show hysteresis between $PrO_{1.80}$ and $PrO_{1.83}$ as the pressure varies between 10^{-5} and 150 mm oxygen. At 465°C the hysteresis loop extends over the entire pressure range. Explorations into the interior of the hysteresis loop show subordinate loops in accordance with the general theory of hysteresis proposed by Everett. Everett's theory is applied to the isotherm at 465°C. The behavior of the praseodymium oxide system is thought of as a result of its being composed of domains of composition $PrO_{1.80}$ changing to domains of $PrO_{1.83}$ as the pressure is increased. The slope of the increasing pressure curve represents the change in the number of molecules in domains in the $PrO_{1.83}$ state. Reduction of the pressure at various points on the increasing pressure envelope produces scanning curves. Graphical analysis of several scanning curves indicates the presence of domains from the 1.78 - 1.80 region and the 1.83 to some higher composition.

2287

Purdue U. Dept. of Chemistry, Lafayette, Ind.

DISSOCIATION CONSTANTS OF THE ACID SALTS OF ETHYLENEDIAM[IN]ETETRAACETIC ACID, by D. C. Olson and D. W. Margerum. [1960] 11p. incl. diagrs. tables, refs. (AFOSR-TN-60-603) (AF 49(638)60) AD 237727 Unclassified

The fully protonated salt of EDTA, H_6YCl_2, is prepared. Its dissociation constants at 25°C and an ionic strength of 2.0 are $KH_6Y^{++} = 0.55$ and $KH_5Y^{+} = 0.11$. The first ionization constant of H_4Y was also determined by a titrimetric method for comparison with H_5Y^{+} and H_6Y^{++} constants. A mechanism is presented for the ionization of the H_6Y^{++} and H_5Y^{+} species which accounts for the relative values of the constants, and which is consistent with the mechanism of Schwarzenbach (Helv. Chim. Acta, v. 30: 1798, 1947) for 4 other ionizations. An alternate mechanism for ionization of EDTA proposed by Chapman (Jour. Chem. Soc. (London), 1766, 1955) does not seem valid in solution.

2288

Purdue U. Dept. of Chemistry, Lafayette, Ind.

KINETICS OF NICKEL(II) LIGAND EXCHANGE REACTIONS: CYANIDE ION AND (ETHYLENEDINITRILO)-

TETRAACETATE ION, by D. W. Margerum, T. J. Bydalek, and J. J. Bishop. [1960] [5 p. incl. diagrs. tables, refs. (AFOSR-1460) [AF 49(638)60] AD 441693 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 1791-1795, Apr. 20, 1961.

Nickel (II) forms mixed complexes with cyanide and (ethylenedinitrilo)-tetraacetate ions. The transition between the octahedral, paramagnetic EDTA complex and the planar, diamagnetic cyanide complex is kinetically controlled by the presence of 3 cyanide ions around nickel. This study indicates that it is not necessary to postulate a direct bimolecular exchange between $Ni(CN)_4^{-2}$ and nickel complexes such as previously reported. (Contractor's abstract)

2289

Purdue U. Dept. of Chemistry, Lafayette, Ind.

IONIZATION OF ETHYLENEDIAMINETETRAACETIC ACID AND ITS ACID SALTS, by D. C. Olson and D. W. Margerum. May 4, 1960, 4p. incl. tables, refs. (Supersedes AFOSR-TN-60-603; AD 237727) (AF 49-(638)60) AD 253092 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 5602-5605, Nov. 5, 1960.

For abstract see item no. 2287, Vol. IV.

2290

Purdue U. Dept. of Chemistry, Lafayette, Ind.

THE METALATION OF DIPHENYLFERROCENYL-CARBINOL, by R. A. Benkeser, W. P. Fitzgerald, and M. S. Melzer. Nov. 10, 1960, 8p. incl. diagrs. (AFOSR-TN-60-1365) (AF 49(638)297) AD 246801 Unclassified

Also published in Jour. Org. Chem., v. 26: 2569-2571, July 1961.

Treatment of diphenylferrocenylcarbinol (I) with n-butyllithium, followed by carbonation with dry ice produced 2-carboxydiphenylferrocenylcarbinol (II) in 73% yield. When compound I was heated or treated with acid it readily converted to compound III, the lactone of II. The structure of II was indicated by its acidic nature and infrared spectrum which showed a strong carboxyl band at 5.95 microns and bands at 9 and 10 microns indicating an unsubstituted C5 ferrocene ring. The ready conversion of II to III places the carboxyl group at the 2- rather than 3- position relative to the alcohol function. The structure of III was indicated by its elemental analysis, molecular weight, and infrared spectrum. The latter showed unambiguous five-membered-ring lactone absorption at 5.6 microns and ferrocene absorption at 9 and 10 microns. The spectrum was devoid of -OH absorption. Metalated I reacted with methyl iodide producing a methylated compound. In order to prove that metalation of I had not occurred in one of the phenyl rings (paralleling the reaction with triphenylcarbinol) rather than in the ferrocene moiety, an authentic sample of ferrocenylphenyl-o-tolylcarbinol IV was synthesized. Compound IV melted at 125°C indicating that the site of metalation was in the ferrocene and not the phenyl ring. Compound III exhibited reactions which are classical for lactones.

2291

Purdue U. Dept. of Chemistry, Lafayette, Ind.

CHEMICAL EFFECTS ARISING FROM SELECTIVE SOLVATION: SELECTIVE SOLVATION AS A FACTOR IN THE ALKYLATION OF AMBIDENT ANIONS, by N. Kornblum, P. J. Berrigan, and W. J. le Noble. [1960] [1 p. incl. table. (AFOSR-TN-60-217) (AF 49(638)324) AD 238794 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 1257, 1960.

A note is presented describing the carbon alkylation which solutions of phenolic salts undergo in the following solvents: water, phenol and fluorinated alcohols. The percentage of O- and C-alkylation produced by the reactions of various allyl and benzyl halides with solutions of sodium phenoxide at 27°C is tabulated. The mechanism of the C-alkylation process is discussed and reasons are given for rejecting a carbonium ion explanation of the second order process.

2292

Purdue U. Dept. of Chemistry, Lafayette, Ind.

THE STEREOCHEMISTRY OF THE BASE-CATALYZED ADDITION OF p-TOLUENETHIOL TO SODIUM AND ETHYL PHENYLPROPIOLATE, by W. E. Truce and D. L. Goldhamer. Apr. 4, 1960, 9p. incl. table, refs. (AFOSR-TN-60-457) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)531 and Office of Ordnance Research under DA 33-008-ORD-983) AD 238348 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 81: 5795, Nov. 5, 1959.

p-Toluenethiol was added to ethyl phenylpropiolate to give, after saponification, trans-β-p-tolylmercaptocinnamic acid, in accord with the rule of trans-nucleophilic addition. However, a violation of this rule is observed when p-toluenethiol is added to sodium phenylpropiolate to give cis-β-tolymercaptocinnamic acid. Dipole moment measurements are used in support of these tentative configurational assignments. (Contractor's abstract)

2293

Purdue U. Dept. of Chemistry, Lafayette, Ind.

ATTEMPTED VIOLATIONS OF THE RULE OF TRANS-NUCLEOPHILIC ADDITION, by W. E. Truce, W. Bannister and others. June 15, 1960, 4p. (AFOSR-TN-60-726) (AF 49(638)531) AD 240587; PB 149322 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 3799-3800, July 20, 1960.

Attempts were made to determine whether bulky mesityl groups would affect the rule of trans-nucleophilic addition by the base-catalyzed addition of mesitylenethiol to mesitylacetylene. The adduct, 1-mesityl-2-(mesitylmercapto)-ethene was of the cis configuration arising from normal trans addition of the nucleophile. Confirmatory evidence for the configuration of the independently synthesized cis- and trans-1-mesityl-2-(mesitylsulfonyl)-ethenes was sought by the use of nuclear magnetic resonance spectroscopy; an adequate solvent for the cis-compound was not found. The coupling constants for the homologous cis- and trans-1-phenyl-2-(phenylsulfonyl)-ethenes were 12.4 and 15.7 cps, respectively. Apparently any steric effect on the part of the mesityl groups in this addition was not great enough to violate the rule. The results indicated that the driving force for thiolates to add in a trans manner is strong enough to overcome adverse steric and electronic factors in the examples.

2294

Purdue U. [Dept. of Mathematics] Lafayette, Ind.

INTEGRATION WITH RESPECT TO OPERATOR-VALUED FUNCTIONS, by G. L. Krabbe. Aug. 4, 1960, 27p. incl. refs. (AFOSR-TN-60-857) (AF 49-(638)505) AD 254741; PB 155834 Unclassified

Also published in Acta Scient. Math., v. 22: 301-319, 1961.

A study is made of the integration of scalar-valued functions with respect to operator-valued functions that are not of bounded variation, $\mathfrak{C}_r$ denotes the Banach space of endomorphisms of $L_r(R, \mu)$, given a fixed measure space (R, μ). Suppose that E_r is a function on J which assumes its values in $\mathfrak{C}_r$; the convergence in $\mathfrak{C}_r$ of the integral $\int_J f(\lambda)\, dE_r(\lambda)$ is studied where f belongs to the class $\mathfrak{D}(J)$ of all simply-discontinuous, complex-valued functions, the integrator E_r need not be of bounded variation. Part III deals with applications to the theory of multipliers of Fourier series.

2295

Purdue U. [Dept. of Mathematics] Lafayette, Ind.

INTEGRATION WITH RESPECT TO OPERATOR-VALUED FUNCTIONS, by G. L. Krabbe. Nov. 15, 1960, 7p. (AFOSR-TN-60-1338) (AF 49(638)505) AD 254742; PB 155835 Unclassified

Also published in Bull. Amer. Math. Soc., v. 67: 214-218, Mar 1961.

A family of continuous homomorphisms of the Banach algebra $W_p(J)$ is constructed, which connects with the theory of multipliers of Fourier series. J is a compact subinterval of the real line. The Banach algebra $W_p(J)$ introduced by N. Wiener contains all complex-valued functions f such that $V_p(f) \neq \infty$, where $V_p(f) = \sup \left(\sum_{k=1}^{n} |f(z_k) - f(z_{k-1})|^p\right)^{1/p}$, the supremum being taken over all finite partitions of J. The basic problem considered is the integration (in the uniform operator-topology) with respect to functions that are not of bounded variation.

2296

Purdue U. [Dept. of Physics] Lafayette, Ind.

ON NEUTRAL SPIN-0 PARTICLES WITH IMAGINARY PARITY, by R. Spitzer. [1960] 6p. (AFOSR-TN-60-179) (AF 18(600)1579) AD 253887 Unclassified

Also published in Nuclear Phys., v. 21: 681-685, Dec. 1960.

Some consequences of the existence of a neutral spin-0 particle with imaginary parity are examined. The particle is subsequently identified with K^0 and it is shown that associated production is a consequence of a superselection law for parity. The parity of the K^0 is fixed by its electromagnetic interaction, which leads to certain results that differ from those predicted by strangeness. The theory accounts directly for the non-conservation of parity in non-neutrino decays of Λ, Σ's, and K's. (Contractor's abstract)

2297

Purdue U. [Dept. of Physics] Lafayette, Ind.

SPIN AND STATISTICS WITH AN INDEFINITE METRIC, by R. Spitzer. [1960] [20]p. (AFOSR-TN-60-180) (AF 18(600)1579) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 82, Jan. 27, 1960.

The quantization of spin-0 fields according to Fermi-Dirac statistics and spin-1/2 fields according to Bose-Einstein statistics is formulated with an indefinite metric in the Hilbert space of quantum mechanical states. The free-field theories are shown to be invariant under a symmetry operation induced by the metric operator. The requirement that the latter commute with the interaction Hamiltonian leads to conservation of the sign of the norm and to a unitary S matrix. The number of the corresponding quanta can change only by 2n (n integer) in any interaction in which probability in the usual sense is conserved. The linear combination of a neutral spin-0 field and its adjoint that corresponds to quanta which are their own antiparticles is examined and found to lead without modification of the selfadjoint character of the Hamiltonian to the possibility that such quanta are unstable. The relevant selection rules

cannot account for new-particle phenomena but may be applicable in the case of transitions of electrons into the superconducting state. (Contractor's abstract)

2298

Purdue U. Dept. of Physics, Lafayette, Ind.

MUON CAPTURE IN C^{12}, by M. Morita and A. Fujii. [1960] [5]p. incl. diagrs. tables. (AFOSR-TN-60-181) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1579 and Atomic Energy Commission) Unclassified

Also published in Nuovo Cimento, Series X, v. 15: 850-852, Mar. 1, 1960.

A general formalism of the muon capture reaction is developed in close analogy to the theory of relativistic corrections in the beta-decay process. The assumption that the j-j coupling shell model with the harmonic oscillator radial wave function is adjusted to the observed nuclear size is given for the choice of the nuclear model used in the calculation of the partial transition rate of the muon capture reaction $\mu^- + C^{12} \rightarrow B^{12} + \nu$, in which the daughter nucleus is found in its ground state. The ratio of the strength of the pseudoscalar and axial vector coupling constant, C_P/C_A, as a parameter is considered and it is found that the partial transition rate ω_μ in units of 10^3 sec^{-1} is $\omega_\mu = 6.28 + 0.00481 \times [(C_P/C_A)-21.2]^2$ with the magnetic moment term and without the term is $\omega_\mu = 4.84 + 0.00481 \times [(C_P/C_A)-21.2]^2$.

2299

Purdue U. Dept. of Physics, Lafayette, Ind.

PHENOMENOLOGY OF Σ-NUCLEON SCATTERING, by M. T. Vaughn. [1960] 20p. incl. refs. (AFOSR-TN-60-646) (AF 18(600)1579) Unclassified

Also published in Nuovo Cimento, Series X, v. 18: 178-190, Oct. 1, 1960.

A discussion is given of some phenomenological aspects of Σ-nucleon scattering. It is noted that with Σ^+ beams likely to be available in the near future, triple scattering experiments are only slightly more difficult than single scattering experiments. A method of determining separately ^1S and ^3S phase shifts at low energies is noted. A discussion is given of the qualitative features of low-energy Σ-nucleon scattering to be expected if one or the other of the global symmetry models $G_{\pi\Sigma} \approx \pm G_{\pi N}$ is valid, and possibilities of distinguishing between the two cases are examined, utilizing the Mandelstam representation for the scattering amplitude, some consequences of which are derived in the appendix. In particular, the analytic properties of the partial wave amplitudes are deduced; it is found that owing to the unequal masses of Σ and nucleon, the singularities of the partial wave amplitudes do not all lie on the real axis in the complex plane of the energy variable. (Contractor's abstract)

2300

Purdue U. Dept. of Physics, Lafayette, Ind.

NEUTRAL LEPTON CURRENTS AND NEUTRINO DETECTION, by R. W. King. [1960] [1]p. (AFOSR-TN-60-1170) (AF 18(600)1579) AD 253889 Unclassified

Also published in Phys. Rev., v. 121: 1201, Feb. 15, 1961.

The interactions of neutrinos with complex nuclei are explored assuming the existence of a neutral lepton current. (Contractor's abstract)

2301

Purdue U. Dept. of Physics, Lafayette, Ind.

AN INTERPRETATION OF THE BERKELEY ANOMALY IN HIGH ENERGY p-d COLLISIONS, by A. Tubis and J. L. Uretsky. [1960] [6]p. incl. diagr. (AFOSR-TN-60-1332) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)1579] and Atomic Energy Commission) AD 250975 Unclassified

Also published in Phys. Rev. Ltrs., v. 5: 513-514, Dec. 1, 1960.

The "bump" observed in the momentum spectrum of mass 3 recoil nuclei in the range corresponding to double pion production is explained without invoking a two-pion resonance as favored by Abashian et al (Phys. Rev. Ltrs., v. 5: 258, 1960). Following these authors, the matrix element is written so as to allow final state p-wave scattering of the mesons. In evaluating the transition probability a zero range approximation for the π-π phase shift is employed. For a scattering length of 2.5 meson Compton wavelengths, the max production cross-section occurs at 300 mev total energy in the two-pion c. m. system. There is a very sharp peak in the recoil nucleons momentum spectrum. It is pointed out that this explanation does not rule out a two-pion resonance at higher energy, while a positive scattering length of the size required here could be related to a two-pion bound state of mass 225 mev.

2302

Purdue U. [Dept. of Physics] Lafayette, Ind.

BOSON FURRY THEOREM, by D. C. Peaslee and M. T. Vaughn. [1960] [3]p. incl. diagrs. refs. [AF 18(600)1579] Unclassified

Published in Phys. Rev., v. 119: 460-462, July 1, 1960.

A Furry theorem for heavy mesons and photons is given for a class of highly symmetric interactions, neglecting

the Ξ - N mass difference. Because of this neglect most rules are only approximately valid, but a few depend on charge conjugation alone and are absolute. (Contractor's abstract)

2303

Purdue U. [Dept. of Physics] Lafayette, Ind.

PHOTOPRODUCTION AND DETECTION OF THE TWO-MESON BOUND STATE, by J. L. Uretsky and T. R. Palfrey, Jr. [1960] [6]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(600)1579] and Atomic Energy Commission) Unclassified

Published in Phys. Rev., v. 121: 1798-1803, Mar. 15, 1961.

The possibility of the detection of a photoproduced 2-pion bound system was investigated. The general detection problem is discussed briefly; the branching ratio between $2\pi^\circ$ and $2\gamma^\circ$ decay modes is calculated; and the total photoproduction cross section is estimated in terms of the binding energy of the 2-pion state both by field-theoretic and by phase-space arguments. It is concluded that if the binding energy is of the order of 10 mev the state should be detectable in photoproduction experiments, and the binding energy should be measurable.

2304

Purdue U. [Dept. of Physics] Lafayetee, Ind.

ELECTROPRODUCTION OF π-MESONS, by R. Blankenbecler, S. Gartenhaus and others. [1960] 11p. incl. diagr. refs. (AFOSR-311) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)767 and Atomic Energy Commission) AD 253888 Unclassified

Also published in Nuovo Cimento, Series X, v. 17: 775-785, Sept. 1, 1960.

An approximate evaluation is made of the dispersion relations for the production of pions in electron-nucleon collisions. The results are applicable at low energies in the final pion-nucleon barycentric system where the assumption that the (3,3) state dominates the dispersion integrals is expected to be valid. Effects due to nuclear recoil and crossing symmetry are treated exactly to all orders. (Contractor's abstract)

2305

Purdue U. Dept. of Physics, Lafayette, Ind.

NEUTRAL LEPTON CURRENTS AND NEUTRINO DETECTION, by R. W. King. [1960] [1]p. [AF 49(638)-767] Unclassified

Published in Phys. Rev., v. 121: 1201, Feb. 15, 1961.

It is pointed out that the existence of a neutral lepton current makes possible new detection techniques for neutrinos. Detection of low-energy antineutrino excitation of a nucleus can be made by observing the subsequent γ emission. The background is reduced by measuring γ-γ coincidence where coincidences are recorded between γ rays of various energy that feed the first excited state and a γ ray of characteristic energy emitted by the first excited state. Reactor antineutrinos are capable of producing the reaction $\nu + Be^9 \rightarrow \alpha + \alpha + n + \nu$, because of the low threshold. Such a reaction might provide an even better means of detection.

2306

Purdue U. Dept. of Physics, Lafayette, Ind.

ELECTRIC POLARIZABILITY OF THE NEUTRON, by A. Kanazawa and S. Tani. [1960] [2]p. (Sponsored jointly by Air Force [Office of Scientific Research under AF 49(638)767] and National Science Foundation) Unclassified

Published in Progr. Theoret. Phys. (Japan), v. 25: 514-515, Mar. 1961.

A summary of the kinematical aspects of the 2-photon interaction is presented as a preliminary survey of further covariant investigations of this problem. The 4-momenta of incoming (outgoing) nucleon and photon are denoted as p and q (p' and q'), respectively. The problem is to list the complete set of gauge-invariant and Lorentz invariant matrix elements. A complete set of 20 expressions is shown. The answer is not unique but there are many equivalent sets.

2307

Purdue U. Jet Propulsion Center, Lafayette, Ind.

ON THE IMPORTANCE OF COMBUSTION CHAMBER GEOMETRY IN HIGH FREQUENCY OSCILLATIONS IN ROCKET MOTORS, by J. R. Osborn and J. M. Bonnell. May 1960, 17p. incl. diagrs. (Rept. no. 260) (AFOSR-TN-60-393) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)756 and Office of Naval Research under N7onr-39418) AD 237692; PB 148235 Unclassified

Presented at ARS semi-annual meeting, Los Angeles, Calif., May 9-12, 1960.

Also published in ARS Jour., v. 31: 482-486, Apr. 1961. (Title varies)

Experiments were conducted to determine some of the underlying factors which contribute to the occurrence of transverse modes of combustion pressure oscillation in rocket motors. Two rocket motors having different diameters and several different lengths were employed in the experiments using a gaseous hydrocarbon fuel and air as propellants. The investigation indicated that changes in the aspect ratio and volume of the rocket motor combustion chamber had a profound effect on the incidence and amplitude of the tranverse modes. These effects were modified by interactions of the transverse

modes with the longitudinal mode. The transverse modes were determined to be the spinning and the radial modes. (Contractor's abstract)

2308

Purdue U. [Jet Propulsion Center] Lafayette, Ind.

ON THE EFFECT OF FUEL COMPOSITION ON HIGH FREQUENCY OSCILLATIONS IN ROCKET MOTORS BURNING PREMIXED HYDROCARBON GASES AND AIR, by J. R. Osborn and J. M. Bonnell. [1960] 6p. incl. refs. (AFOSR-TN-60-1431) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)756 and Office of Naval Research under N7onr-39418) Unclassified

Presented at Fifteenth annual meeting of the Amer. Rocket Soc., Shoreham Hotel, Washington, D. C., Dec. 5-8, 1960.

Also published in ARS Jour., v. 31: 1397-1401, Oct. 1961.

The experiments reported herein were concerned with the determination of some of the factors which contribute to the occurrence of transverse and longitudinal modes of combustion oscillation in rocket motors burning gases. Three rocket motors having different combustion chamber geometries were employed, using gaseous hydrocarbon fuels premixed with air as propellants. The fuels were methane, ethane, superheated propane, ethylene, and hydrogen. The results indicated that the incidence and amplitude of the combustion pressure oscillations were profoundly influenced by the coupled effects of the chemical composition of the fuels, and the aspect ratio of the cylindrical combustion chamber. It was demonstrated that in the chamber pressure range investigated the saturated hydrocarbons sustained only the fundamental transverse modes, while the unsaturated hydrocarbons and also hydrogen were capable of sustaining combinations of modes, and modes higher than first order.

2309

Purdue U. [Jet Propulsion Center] Lafayette, Ind.

TWELFTH AFOSR CONTRACTORS' MEETING ON LIQUID PROPELLANT ROCKET COMBUSTION, Mar. 2-3, 1960 [12]p. (AFOSR-TR-60-37) [AF 49(638)756] AD 237729; PB 148234 Unclassified

This report contains 13 resumes of papers presented at the meeting. The topics discussed include: (1) combustion in gaseous rocket motors, (2) interactions among burning fuel droplets, (3) stability of laminar flame propagation, (4) general solution to combustion instability, (5) high frequency oscillatory combustion in rocket motors, (6) scaling procedures for liquid rockets, (7) observations of burning propellants in rockets, (8) acoustic instability in rocket chambers, (9) tangential instability in rocket chambers, (10) research on liquid rocket motors, (11) chemical kinetics, (12) radiation in rocket motors, and (13) ions in rocket combustion products.

2310

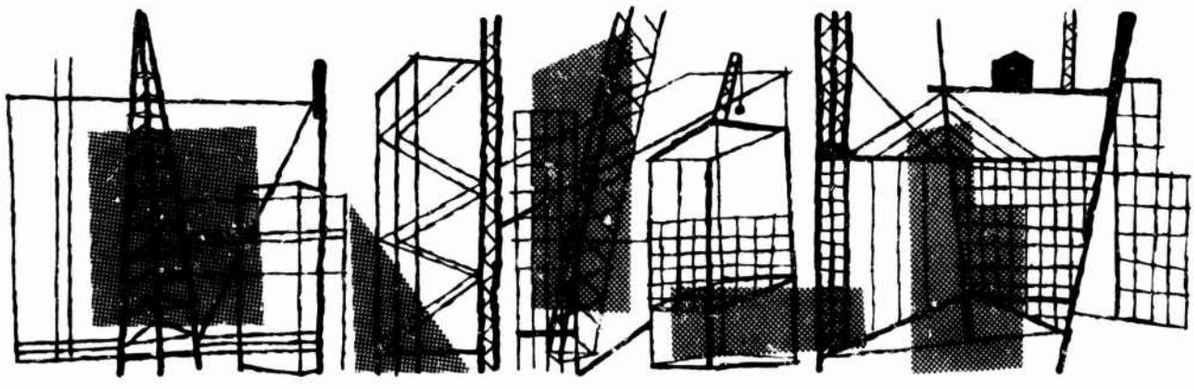
Purdue U. [Jet Propulsion Center] Lafayette, Ind.

SOME INSTRUMENTATION FOR COMBUSTION STABILITY RESEARCH, by J. R. Osborn. [1960] [29]p. incl. illus. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)756 and Office of Naval Research under N7onr-39418) Unclassified

Presented at ARS semi-annual meeting, Los Angeles, Calif., May 9-12, 1960.

Published in Prog. in Astronaut. and Rocketry, v. 2: 145-173, 1960.

Several instrumentation systems which have been used in liquid propellant rocket motors experiencing high frequency unstable combustion are described. These systems are high frequency static pressure transducers, static pressure transducers in conjunction with an input coupler, high speed motion picture cameras, and photomultipliers. Operation of each of the devices in a screaming rocket motor is shown and compared for fidelity of operation and difficulty of use. In addition, some dynamic calibration methods are presented. (Contractor's abstract)



2311

Radio Corp. of America. [Astro-Electronics Div.] Princeton, N. J.

RESEARCH ON PLASMA ACCELERATION BY ELECTRIC FIELD GRADIENT. Semi-annual technical rept. June 30-Dec. 31, 1959, 39p. incl. illus. diagrs. table, refs. (AFOSR-TN-60-211) (AF 49(638)658) AD 232096; PB 145873 Unclassified

Theoretical and experimental studies of plasma acceleration by nonuniform RF fields are presented. Theoretical considerations indicate that a plasma will be accelerated toward the low-field region if the applied frequency is greater than the plasma frequency and toward the high-field region if the frequency is less than the plasma frequency. Pulses of mercury plasma were generated in a reproducible way, and an RF system was designed and operated. Phototubes and electron and ion pickup probes were used for detecting the moving plasma. Oscillograms show a change in plasma velocity as the RF field is applied. This report also contains Appendix A: Plasma acceleration by alternating electric field gradient, by T. W. Johnston, and Appendix B: Asymptotic solutions of the plasma equations of motion. (Contractor's abstract, modified)

2312

Radio Corp. of America. [Astro-Electronics Div.] Princeton, N. J.

PLASMA ACCELERATION IN A RADIO-FREQUENCY FIELD GRADIENT, by G. A. Swartz, T. T. Reboul and others. [1960] [8]p. incl. diagrs. refs. (AFOSR-TN-60-496) (AF 49(638)658) Unclassified

Also published in Phys. Fluids, v. 3: 973-976, Nov.-Dec. 1960.

Experiments have been performed at 140 mc to determine the acceleration of a mercury plasma in an rf field gradient. With a maximum rf field amplitude of 170 v/cm, a tenuous plasma (of density less than a critical density) was accelerated from 5×10^5 to 25×10^5 cm/sec. A denser plasma (of density greater than the critical density) was decelerated in the same field. These experimental results are consistent with a theory based on energy considerations. (Contractor's abstract)

2313

Radio Corp. of America. Astro-Electronics Div., Princeton, N. J.

PLASMA ACCELERATION BY A QUASI-STATIC RF ELECTRIC FIELD GRADIENT, by T. T. Reboul, G. D. Gordon, and G. A. Swartz. [1960] 15p. incl. illus. (ARS rept. no. 1532-60) (AFOSR-TN-60-997) (AF 49(638)658) AD 255041 Unclassified

Presented at Fifteenth annual meeting of the ARS, Washington, D. C., Dec. 5-8, 1960.

Theoretical and experimental phases of the acceleration of a plasma by a quasistatic rf electric field gradient were studied. Theoretical studies indicate that a plasma will be accelerated toward the low-field region if the applied frequency is greater than a critical frequency of the plasma, and toward the high-field region if the frequency is less than the critical frequency. The critical frequency is a function of ion density and is equal to the electron plasma frequency for a plasma slab with the rf field perpendicular to its face. Acceleration and deceleration of plasma were observed experimentally. The observed acceleration is consistent with the theoretical predictions. A tenuous mercury plasma (critical frequency less than the applied frequency of 140 mc) was accelerated from 500,000 cm/sec to 2,500,000 cm/sec as the maximum electric field was increased from zero to 170 v/cm. Denser plasmas were decelerated in the same field. (Contractor's abstract)

2314

Radio Corp. of America. [Astro-Electronics Div.] Princeton, N. J.

THE INTERACTION OF MICROWAVES WITH PLASMAS, by M. Glicksman. [1960] [25]p. incl. diagrs. (AFOSR-TN-60-1368) (AF 49(638)658) Unclassified

Presented at RCA Microwave Symposium, June 6, 1960.

Two related topics are presented in this report. The first, presented in elementary form, is a discussion of the forces acting on a plasma in an rf field gradient. The rest of the work is concerned with experimental tests of these forces and their behavior at frequencies in the neighborhood of the plasma frequency. Observations of the propagation of slow waves in bounded mercury and cesium plasmas have been made, and the information obtained on the properties of the plasmas is discussed. (Contractor's abstract)

2315

Radio Corp. of America. Astro-Electronics Div., Princeton, N. J.

RESEARCH ON PLASMA ACCELERATION BY ELECTRIC FIELD GRADIENT, Semi-annual technical rept. Jan. 1-June 30, 1960, 65p. incl. illus. diagrs. table, refs. (AFOSR-TR-60-120) (AF 49(638)658) AD 613307 Unclassified

Theoretical studies of plasma acceleration by an rf field gradient indicated that a plasma will be accelerated toward the low-field region if the applied frequency is

greater than the critical frequency of the plasma, and toward the high-field region if the frequency is less than the critical frequency. Calculations for the acceleration of plasma spheres and ellipsoids of arbitrary orientation with respect to the rf field have been completed. Experiments with plasmas of various densities have demonstrated both the acceleration and deceleration of the plasmas as predicted by theory. Mercury plasma has been accelerated with a 140-mc rf field gradient to a velocity of 25×10^5 cm/sec, equivalent to a specific impulse of 2500 sec. (Contractor's abstract)

2316

Radio Corp. of America. Astro-Electronics Div., Princeton, N. J.

PLASMA ACCELERATION BY NON-UNIFORM RF FIELDS (Abstract), by T. T. Reboul, G. A. Swartz and others. [1960] [2]p. (Bound with its AFOSR-TN-60-405; AD 235949) (AF 49(638)658) Unclassified

Presented at Third AFOSR Contractors' meeting on Ion and Plasma Propulsion, Republic Aviation Corp., Farmingdale, N. Y., Mar. 22-24, 1960.

Since the last meeting (see item no. 1815, Vol. III), experiments have demonstrated that a plasma can be accelerated by a non-uniform rf field. In addition, theoretical work was extended from the single particle model to a plasma type model which includes both charges. The theoretical work yielded interesting new results: namely, that the force on a plasma in a non-uniform rf field varies with frequency and reverses sign at the plasma frequency ω_p. For frequencies greater than ω_p, the force is opposite in direction to the field gradient. In addition, for operation at identical frequencies and fields, calculations show that the force exerted by the non-uniform rf field on the plasma can be much larger than that exerted on ions only. In the experiments, an igniter source generates pulses of mercury plasma which diffuse into a region of high rf field gradient. A 140 mc oscillator, capable of a power output of 750 w, produces the rf field. Phototube and electron and ion probes detect the moving plasma. Because of ambipolar diffusion, the plasma attains a velocity of about 4×10^5 cm/sec in the absence of the rf field. As the field is increased, the plasma velocity is observed to increase to a value of about 2.5×10^6 cm/sec for a max rf field of 170 v/cm. This velocity is attained by a plasma pulse with a max density of about 10^8 particles/cm^3.

2317

Radio Corp. of America. [Astro-Electronics Div.] Princeton, N. J.

PLASMA ACCELERATION IN AN rf FIELD GRADIENT-THEORY (Abstract), by G. D. Gordon. [1960] [1]p. [AF 49(638)658] Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 350, June 15, 1960.

The velocity change of a plasma moving through an rf field gradient has been calculated on the basis of energy considerations. A fully ionized plasma, of constant density ρ, is assumed to form a thin slab perpendicular to the rf electric field E. The plasma is assumed to move adiabatically from a high rf field region to one of zero field. It attains a velocity v_f if

$$v_f = \left\{ v_i^2 + \frac{\omega_p^2 \epsilon_0 E^2}{2\rho} \left(\frac{\omega^2 - \omega_p^2}{(\omega_p^2 - \omega^2)^2 + (\omega\nu)^2} \right) \right\}^{1/2},$$

where v_i is its initial velocity, ν the collision frequency, ϵ_0 the permittivity of free space, ω the applied frequency, and ω_p the plasma frequency. Depending on whether ω is greater or less than ω_p, the final velocity can be greater or less than the initial velocity, in agreement with the detailed calculations of T. W. Johnston. Extensions of the theory to other plasma geometries will be given.

2313

Radio Corp. of America. [Astro-Electronics Div.] Princeton, N. J.

PLASMA ACCELERATION IN AN rf FIELD GRADIENT-EXPERIMENTAL (Abstract), by G. A. Swartz, H. W. Lorber, and T. T. Reboul. [1960] [1]p. [AF 49(638)658] Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 351, June 15, 1960.

The plasma acceleration predicted in the previous paper (item no. 2317, Vol. IV) has been observed in the laboratory. A blob of mercury plasma emerges from a small aperture into a 140-mc rf field which decreases monotonically in space. After the plasma reaches zero field region, it is detected by a series of wire probes. The plasma velocity is determined from transit time measurements between the aperture and the probes. With a maximum amplitude of the rf field of 170 v/cm, a plasma with a density of about 5×10^8 ions/cm^3 was accelerated from 5×10^5 cm/sec to 25×10^5 cm/sec. For this blob, $\omega_p/2\pi = 118$ mc. When the plasma density was increased to 10^{10} ions/cm^3 ($\omega_p/2\pi = 520$ mc), the

plasma was decelerated. These experimental results agree quantitatively with theory. Plasma density fluctuations with a period of 6 μ sec have been observed in the accelerated plasma.

Reaction Motors, Inc., Denville, N. J. see
Thiokol Chemical Corp. Reaction Motors, Inc., Denville, N. J.

2319

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

EFFECT OF SURFACE MASS-TRANSFER ON THE IMPULSIVE MOTION OF AN INFINITE PLATE AT HYPERSONIC SPEEDS IN A VISCOUS COMPRESSIBLE FLUID, by T. Y. Li. Sept. 1961, 52p. incl. diagrs. tables. (Rept. no. TR-AE-6005) (AFOSR-TN-60-956) (AF 18(600)1591) AD 246621; PB 153315
Unclassified

Presented at meeting of the Amer. Rocket Soc., Los Angeles, Calif., May 9-12, 1960.

The effects are examined of mass-transfer on an infinite flat plate surface when the plate executes an impulsive motion at hypersonic speeds in a viscous compressible fluid. K. Stewartson (Cambridge Phil. Soc., 1955) considered the corresponding problem for an impermeable surface. The law of surface mass-transfer which yields a similar solution for the viscous boundary layer is derived. The solution for the viscous region can be obtained by an extension of Stewartson's result. The matching at the interface between the viscous and inviscid regions is accomplished by Stewartson's procedure. Solutions are obtained in explicit closed forms which give complete information on the effects of surface mass-transfer on the strong interaction between shock wave and boundary layer. Numerical examples are discussed. (Contractor's abstract)

2320

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

THE RECENT ADVANCES IN NONEQUILIBRIUM FLOW IN GAS DYNAMICS, by T. Y. Li. May 1960, 58p. incl. diagrs. refs. (Rept. no. TR-AE-6001) (AFOSR-TN-60-957) (AF 18(600)1591) AD 244464
Unclassified

Also published in ARS Jour., v. 31: 170-178, Feb. 1961.

General concepts are discussed which include: (1) the fundamental equations and boundary conditions in problems of steady adiabatic inviscid flow of a reacting mixture of perfect gases and (2) a general study of the chemical relaxation in a gaseous system. The steady 1 dimensional nozzle flow with nonequilibrium chemical reactions is considered. An important nondimensional parameter is used to classify the nozzle flow into (1) equilibrium flow, (2) nonequilibrium flow, and (3) frozen flow. Significant departure from equilibrium flow in a hypersonic shock tunnel nozzle would lead to frozen flow further downstream. Results are given of a numerical analysis of the inviscid adiabatic flow of a reacting mixture of perfect gases past a blunt body. Significant changes in the flow conditions of the shock layer region are shown to be attributed to the chemical nonequilibrium effects. (Contractor's abstract)

2321

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

STABILITY OF A VORTEX SHEET IN NON-EQUILIBRIUM FLOWS, by K. C. Wang. [1960] [38]p. incl. diagrs. (Rept. no. TR-AE-6007) (AFOSR-48) (AF 18(600)1591) AD 252391; PB 155273 Unclassified

The stability of a plane vortex sheet between two uniform streams with respect to small disturbances is examined when the two media are dissociating diatomic gases such as oxygen or nitrogen. For the equilibrium and frozen cases, it is found that the eigenvalue equation is formally identical with that of the conventional case, and the stability is decreased due to the dissociation. For the non-equilibrium case, the eigenvalue equation is a complex one and depends on the wave number of the disturbances, the vortex sheet is shown to be always unstable. Included also is a discussion of the stability of a vortex sheet between two equal but opposite steady streams from the consideration of pressure distribution. (Contractor's abstract)

2322

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

RECENT ADVANCES IN NONEQUILIBRIUM DISSOCIATING GAS DYNAMICS, by T. Y. Li. Dec. 1960 [44]p. incl. diagrs. refs. (Rept. no. TR-AE-6008) (AFOSR-49) (AF 18(600)1591) AD 232392; PB 155274
Unclassified

Also published in ARS Jour., v. 31: 170-178, Feb. 1960.

Gas dynamics is studied in relation to inviscid flow problems. In hypersonic flight regime, high stagnation enthalpies are realized which are sufficient to cause dissociation. When the time to reach equilibrium is comparable with the time it takes for the fluid particle to pass through the flow, there then exists regions of the flow field in which non-equilibrium states are encountered. (Contractor's abstract, modified)

2323

Rensselaer Polytechnic Inst. [Dept. of Aeronautical Engineering] Troy, N. Y.

HYPERSONIC FLOW NEAR THE LEADING EDGE OF A FLAT PLATE, by H. T. Nagamatsu and T. Y. Li. [1959] [2]p. incl. diagrs. [AF 18(600)1591] Unclassified

Published in Phys. Fluids, v. 3: 140-141, Jan.-Feb. 1960.

A first-order theory based upon the kinetic theory of gases has been developed to explain the existence of the slip region at the leading edge. After close study of the flow characteristics in the test section, it was decided that the mean free path is small enough so that the rarefied gas slip formula, strictly speaking, does not apply. It seems, therefore, that the present slip phenomenon is not quite the same as predicted in the Maxwell formula. Results indicate that in a continuum flow, when Mach number M >> 1, slip can take place in a limited region on the flat plate near the leading edge.

2324

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

SOME EFFECTS OF SURFACE CURVATURE ON THE LAMINAR BOUNDARY LAYER FLOW, by K. Toba. Mar. 1960 [24]p. incl. diagrs. (Rept. no. TR-AE-5904) (AFOSR-TN-60-448) (AF 49(638)23) AD 237088; PB 147754 Unclassified

In a recent analysis of K. T. Yen (item no. RPI.09:001, Vol. II) a new theory of laminar boundary layer flow is presented. By adopting the natural coordinates the boundary layer approximation is made so that surface curvature effects are taken into account. In this report, further elaboration of the proposed formulation is made and the effects of surface curvature are evaluated for a family of surfaces which yield similar solutions. Numerical results for the velocity profiles and the wall skin friction distribution obtained by means of a high speed computer are presented and analyzed. (Contractor's abstract)

2325

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

A STUDY OF SOME FLUID MIXING PROBLEMS, by K. Toba, M. Breslau and K. T. Yen. Aug. 1960, 32p. incl. tables. (Rept. no. TR-AE-6003) (AFOSR-TN-60-1023) (AF 49(638)23) AD 243859 Unclassified

An analytical study was made of some 2-dimensional fluid mixing problems. The conditions under which similar solutions exist for mixing under streamwise pressure gradients are determined. It is shown that the 2 streams should have the same Mach numbers, and the mainflow velocity distributions should be of the wedge or exponential flow type. Transverse pressure gradients are also included in the consideration. It was found that the free-stream velocity distributions should also be of the wedge or exponential flow type and, in addition, the total heads of the 2 fluid streams should be the same. Finally, the von Karman-Pohlhausen method is used to allow for more realistic pressure gradients. The dependence of the interface curvature on the injection velocity, the pressure gradients, etc. are indicated. (Contractor's abstract)

2326

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

ON THE MAGNETOHYDRODYNAMIC BOUNDARY LAYER THEORY, by K. T. Yen. Sept. 1960, 19p. incl. refs. (Rept. no. TR-AE-6004) (AFOSR-TN-60-1162) (AF 49(638)23) AD 246623; PB 153262 Unclassified

Boundary layer equations for two-dimensional steady magneto-hydrodynamic flows are derived and some physical problems such as the relative order of magnitude of viscous and magnetic terms, the velocity and magnetic field boundary layer thicknesses, etc. are discussed. The momentum and energy integral equations for magneto-hydrodynamics are also obtained. The magneto-hydrodynamic flow over a flat plate, analyzed by Greenspan and Carrier when β approaches one, is shown to have another solution when the electric conductivity of the fluid is very large and $\beta = 1$. The result shows that the flow is plugged but the magnetic field is uniform and undisturbed. The second flow is concerned with jet mixing under a magnetic field directed along the jet axis. The flow plugging phenomenon is also found to occur.

2327

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

LAMINAR JET MIXING OF AN ELECTRICALLY CONDUCTING FLUID IN THE PRESENCE OF A MAGNETIC FIELD, by K. Toba. [1960] [2]p. incl. diagrs. (AFOSR-TN-60-1364) (AF 49(638)23) Unclassified

Also published in Jour. Aero/Space Sci., v. 28: 667-668, Aug. 1961.

A mathematical supplementary consideration is made for the small magnetic Reynolds number case treated in a previous paper (see item no. 995, Vol. III) as well as for the large magnetic Reynolds number case.

2328

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

STUDY OF FLUID MIXING AND RELATED AERODYNAMIC PROBLEMS, by K. T. Yen. Final rept. Sept. 1960, 10p. incl. refs. (Rept. no. TR-AE-6006) (AFOSR-TR-60-136) (AF 49(638)23) AD 246622
Unclassified

The aim of this project is to investigate the mixing of fluid streams abd related problems in fluid mechanics. Topics considered are effects of jet mixing on the thrust generation of the jet flap, boundary layer flows over a curved surface, optimal coordinates for viscous flow, and supersonic rotational flow.

2329

Rensselaer Polytechnic Inst. [Dept. of Aeronautical Engineering] Troy, N. Y.

A THEORY OF THE TWO-DIMENSIONAL LAMINAR BOUNDARY LAYER OVER A CURVED SURFACE, by K. T. Yen and K. Toba. [1960] [8]p. incl. diagrs. (AFOSR-3866) (AF 49(638)23) Unclassified

Also published in Jour. Aero/Space Sci., v. 28: 877-884, Nov. 1961.

The problem of 2-dimensional viscous flow is first formulated by using the streamlines and their orthogonal trajectories as the generalized coordinates. A boundary-layer approximation is applied to the Navier-Stokes equations and the Gauss equation in the boundary-layer equations. The conditions under which similar solutions of the boundary-layer equations exist are determined. By a simple transformation, the governing differential equation can be expressed in a form which reduces to the Falkner-Skan equation for zero surface curvature. Numerical results for a similar solution which corresponds to a flow over a curved surface with zero surface pressure gradient have been obtained. The velocity profiles in the boundary-layer and the wall skin-friction distribution for concave and convex surfaces are presented. The wall skin friction for a convex wall is found to be higher than the Blasius value for a flat plate. For a concave wall, the skin friction will drop below the Blasius value as the curvature increases, but it appears to reach a minimum, and beyond this minimum point it will increase again. (Contractor's abstract)

2330

Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.

ON THE INDETERMINATENESS OF THE BOUNDARY CONDITIONS FOR THE MIXING OF TWO PARALLEL STREAMS, by K. T. Yen. [1959] [3]p. incl. diagr. (AF 49(638)23) Unclassified

Presented at the annual meeting of the Amer. Soc. of Mech. Engineers, Atlantic City, N. J., Nov. 29-Dec. 4, 1959.

Published in Jour. Appl. Mech., v. 27: 390-392, Sept. 1960.

A method is given for the determination of the interface velocity, the location of the interface in the mixing region, and the transverse force acting on the dividing wall as a consequence of the mixing. Based on available numerical data, calculations have been made for 2 free-stream velocity ratios, 0.5 and 0. It is shown that values of interface velocity obtained here differ appreciably from those obtained using other proposed boundary conditions (the third condition). In addition, for a free-stream velocity ratio of 0.5 the interface deflects towards the higher velocity stream while for a zero free-stream velocity it deflects towards the zero (lower) velocity stream. (Contractor's abstract)

2331

Rensselaer Polytechnic Inst. [Dept. of Aeronautical Engineering] Troy, N. Y.

INCOMPRESSIBLE WEDGE FLOWS OF AN ELECTRICALLY CONDUCTING VISCOUS FLUID IN THE PRESENCE OF A MAGNETIC FIELD, by K. T. Yen. [1960] [2]p. (AF 49(638)23) Unclassified

Published in Jour. Aero/Space Sci., v. 27: 74-75, Jan. 1960.

The governing differential equations discussed by Neuringer and Ilroy (Jour. Aeronaut. Sci., v. 25: 194, Mar. 1958) are presented and analyzed. The boundary conditions for transverse as well as longitudinal magnetic fields are considered.

2332

Rensselaer Polytechnic Inst. [Dept. of Aeronautical Engineering]]Troy, N. Y.

OPTIMAL COORDINATES FOR A SIMPLE SHEAR FLOW OVER A FLAT PLATE, by K. T. Yen. [1959] [9]p. (AF 49(638)23) Unclassified

Published in Zeitschr. Angew. Math. Phys., v. 11: 228-236, 1960.

By use of the best coordinates the boundary layer solutions can be obtained valid over a whole field of flow, and a smooth transition from boundary layer flow to external flow can be achieved. It is shown that for a simple viscous shear of an incompressible fluid over a semi-infinite plate, parabolic coordinates can be used as the optimal coordinates.

2333

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

A PRECISION CONDUCTANCE BRIDGE OF NEW DESIGN, by G. J. Janz and J. D. E. McIntyre. June 1960 [17]p. incl. illus. diagrs. tables, refs. (Technical note no. 12) (AFOSR-TN-60-652) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)50 and Office of Naval Research) AD 240365; PB 149436 Unclassified

Also published in Jour. Electrochem. Soc., v. 108: 272-276, Mar. 1961.

A conductance bridge is described in which the essential component is a precision impedance comparator and which combines speed, wide range, and high accuracy in measurements. While fundamentally similar in design and operation to the precision a-c conductance bridges known today, the present design has the attractive features of simplicity of construction from unitized components available on the market, and provision for use of the "four-leads" cell technique to eliminate connecting lead effects in remote conductance measurements. (Contractor's abstract)

2334

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

IONIC NATURE OF MOLTEN SALTS, by G. J. Janz. Dec. 1960, 14p. incl. diagrs. tables, refs. (AFOSR-TR-60-176) (AF 49(638)50) AD 251480; PB 171535 Unclassified

Techniques for precise measurements of physical and electrical properties of molten salts up to 1000°C are discussed. Experimental studies were limited to the class of inorganic salts where the structural units in the crystal state are predominantly ionic; salts in which simple molecular species exist in the molecular state were also included. A density balance with accessories for measuring density, surface tension and viscosity is discussed. A twin capillary design was used to attain a path of sufficient length in the melts to allow precise measurement of electrical conductivity. Other techniques applied in this study were cryoscopy, heat of fusion, calorimetry, ionic transport studies and Raman spectroscopy. In the comparison of aqueous ionic solutions and molten salts the important features to consider include experimental differences (high temperature, conductivity and reactivity of the molten salts), and general concepts.

2335

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

STRUCTURE OF MOLTEN MERCURIC HALIDES. IV. MERCURIC BROMIDE-ALKALI METAL BROMIDE MIXTURES, by G. J. Janz and J. Goodkin. [1960] [4]p. incl. table, refs. (AFOSR-3796) [AF 49(638)50] Unclassified

Published in Jour. Phys. Chem., v. 64: 808-811, June 1960.

An investigation of the cryoscopy of molten $HgBr_2$ having Li, Na, K, Rb and Cs/Br as solutes is reported. The solvent exhibits only small deviations from the thermodynamically ideal behavior predicted for $\nu = 1$ in each mixture. These results, together with the earlier data on electrical conductance and viscosity for the mixtures are in accord with strong solvent-solute interactions and a highly ionic nature for the mixtures. An explanation of the cryoscopic properties is seen in the interaction of the solute with the molecular solvent with the probable formation of the species M^+ and $(MHgBr)_4^-$ in these mixtures. (Contractor's abstract)

2336

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

CONDUCTANCES OF HYDROGEN HALIDES IN ANHYDROUS POLAR ORGANIC SOLVENTS, by G. J. Janz and S. S. Danyiuk. [1959] [26]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)50] and Atomic Energy Commission) Unclassified

Published in Chem. Rev., v. 60: 219-234, Apr. 1960.

The ionization of hydrogen halides in organic solvents involves three processes. These are dependent upon the electron-donor ability of the base, the acceptor properties of the acid, and the dielectric constant of the media. Hence, solvent molecules with available donor electrons and low ionization potentials will readily form ionic addition compounds with hydrogen halides. Electrolytic dissociation of these compounds is governed in turn by the dielectric properties of the solvent.

2337

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

HEAT AND ENTROPY OF FUSION AND CRYOSCOPIC CONSTANT OF SILVER NITRATE, by G. J. Janz, D. W. James, and J. Goodkin. [1960] [2]p. incl. tables, refs. [AF 49(638)50] Unclassified

Published in Jour. Phys. Chem., v. 64: 937-938, July 1960.

Calorimetric measurements on $AgNO_3$ yielded 2960 cal/mol for the heat of fusion, 614 e.u./mol for the entropy of fusion, and 26.47 degree/mol/1000g for the cryoscopic constant.

2338

Rensselaer Polytechnic Inst. [Dept. of Chemistry] Troy, N. Y.

STATISTICAL BIFURCATION OF FRICTION, by F. F. Ling and R. S. Weiner. Jan. 10, 1960 [25]p. incl. illus. diagrs. refs. (Technical note no. 5) (AFOSR-TN-60-207) (AF 49(638)67) AD 234296 Unclassified

Also published in Jour. Appl. Mech., v. 28: 213-217, June 1961. (Title varies)

A description is presented in modified form of an apparatus used earlier (item no. RPI.13:004, Vol. II) for measuring adhesion, pure-shear and friction; the modification made it possible to extend the range of normal load so that the so-called extreme pressures are reached. Actual areas of contact are measured qualitatively by means of electric contact resistances and quantitatively by scanning the specimen with a microscope. The result of a large number of tests shows a statistical bifurcation of frictional resistance for lead on lead. In other words, below extreme pressures there are 2 branches of the coefficient of friction normal load relationship, an upper and a lower branch. The magnitudes of the coefficients of friction of the branches lie within the range of values for lead on lead given by Bowden and Tabor (Friction and Lubrication of Solids, Oxford, Clarendon Press, 1950, p. 124), who did not observe the bifurcation feature. The nature of the upper branch of the coefficient of friction vs normal load relationship is explicable in terms of the weld-junction theory exclusively. The lower branch, however, is not so explicable. (Contractor's abstract)

2339

Rensselaer Polytechnic Inst. [Dept. of Chemistry] Troy, N. Y.

WELDING ASPECT OF SLIDING FRICTION BETWEEN UNLUBRICATED SURFACES, by F. F. Ling. Final rept. June 30, 1960 [40]p. incl. illus. diagrs. tables, refs. (AFOSR-TR-60-117) (AF 49(638)67) AD 243444 Unclassified

The welding aspect of friction for unlubricated metallic surfaces is discussed. Also presented is a theoretical and experimental investigation of adhesion in which the coefficient of adhesion is related to 2 important parameters: activation energy of the process and a time exponent. (Contractor's abstract)

2340

Rensselaer Polytechnic Inst. [Dept. of Chemistry] Troy, N. Y.

THE REACTION OF DIBORANE AND OXYGEN UNDER EXPLOSIVE AND PRE-EXPLOSIVE CONDITIONS, by W. H. Bauer, M. S. Goldstein, and S. E. Wiberley. [1960] [23]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)897] and National Science Foundation) Unclassified

Presented at ARS Propellants, Combustion, and Liquid Rockets Conf., Columbus, Ohio, July 18-19, 1960.

Published in Prog. in Astronaut. and Rocketry, v. 2: 327-349, 1960.

The reaction between oxygen and diborane was studied in the pre-explosion and the explosion region, near the second pressure-temperature explosion limit. In the explosive reaction, diborane reacted first with oxygen to evolve hydrogen. In case the initial mol ratio of oxygen to diborane was 3/2 or less, all the hydrogen in the diborane was recovered as H_2. At temperatures and pressures near the explosion limit conditions, a slow oxidation of diborane takes place, with an initial rate of 3/2 order with respect to the concentration of diborane and independent of the oxygen concentration. The energy of activation calculated from the temperature coefficient of the initial rate was 35 kcal/mol diborane. A spontaneously explosive region of pressures was found at 25°C for the oxygen-diborane systems in 3 to 1 ratio, from 500 to 1050 mm Hg total pressure, occurring in 5 to 15 min after mixing. An unstable partial oxidation product, $H_2B_2O_3$, was isolated and found to be identical with that formed in the oxidation of pentaborane. A reaction mechanism, consistent with the reaction characteristics, is proposed. (Contractor's abstract)

2341

Rensselaer Polytechnic Inst. [Dept. of Chemistry] Troy, N. Y.

KINETICS OF OXIDATION OF DIBORANE AND OF SYM-DIETHYL DIBORANE (Abstract), by W. H. Bauer. [1960] [2]p. (AF 49(638)897) Unclassified

Presented at First AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, General Dynamics Corp., General Atomic Div., San Diego, Calif., Sept. 6-7, 1960. (AFOSR-TN-60-1063; AD 246174)

The oxidation of diborane under near explosive conditions have lead to the proposal of the mechanism: (1) $B_2H_6 \rightleftarrows 2BH_3$; (2) $BH_3 + O_2 \rightarrow BH_3O + O$; (3) $O + B_2H_6 \rightarrow BH_3O + BH_3$; (4) $BH_3O + B_2H_6 \rightarrow BH_3 + B_2H_6O$; (5) $B_2H_6O + O_2 \rightarrow H_2B_2O_3 + 2H_2$; (6) $H_2B_2O_3 \rightarrow B_2O_3 + H_2$;

(7) $BH_3 + O_2 + M \rightarrow BHO_2 + H_2 + M$; (8) $BHO_2 \xrightarrow{wall} B_2O_3 + H_2$; and (9) $BH_3O \xrightarrow{wall} B_2O_3 + H_2$. It is postulated that the homogeneous gas reaction takes place with $H_2B_2O_3$ as a direct intermediate. In addition, explosion limits of temperature and pressure have been determined for mixtures of sym-diethyl-diborane and oxygen (ratio 1 to 9). A very sharp and reproducible explosion limit was found, showing no explosion peninsula with second limits. The limits varied from 500 mm Hg total pressure at 70°C to 10 mm at 200°C.

2342

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

SURFACE-CATALYZED EXCITATIONS IN THE OXYGEN SYSTEM, by G. Mannella and P. Harteck. [1960] [4]p. incl. illus. refs. (AFOSR-1954) (Sponsored jointly by Air Force Cambridge Research Center and Air Force Office of Scientific Research under [AF 49(638)-926]) Unclassified

Also published in Jour. Chem. Phys., v. 34: 2177-2180, June 1961.

A luminosity is produced over Ni maintained at approximately 20°C in a stream of O atoms. Spectroscopic investigation shows the $b\,^1\Sigma_g^+ - X\,^3\Sigma_g^-$ atmospheric system and $A\,^3\Sigma_u^+ - X\,^3\Sigma_g^-$ Herzberg system of the O_2 molecule plus 4 strong heads of the (O,O) band of the OH $A\,^2\Sigma^+ - X\,^2\Pi$ interaction. Certain spectral features in the region of the (O,O) atmospheric band could not be resolved for positive identification but are suggested to be the vibrational rotational bands of OH. The Herzberg and atmospheric bands appear to be primary products of the surface catalysis while the OH molecule can be either a surface product or the result of chemical reactions of certain excited species present. (Contractor's abstract)

2343

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

DYNAMIC EFFECTS ON ELASTIC STRUCTURES, by G. [H.] Handelmann and W. [E.] Boyce. Technical summary rept. [1958] [19]p. incl. diagrs. (AF 18(600)1586) Unclassified

Presented at AFOSR Contractors' meeting, Mechanics Div., Midwest Research Inst., Kansas City, Mo., Oct. 23-24, 1958.

The problem of the determination of the influence of a tip mass on the traverse vibrations of a uniform, untwisted, rotating, clamped beam is analyzed. Topics considered are: (1) upper and lower bounds for the second frequency, (2) eigenvalues of the second order problem, and (3) asymptotic solutions in terms of α.

2344

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

BUCKLING OF A COLUMN WITH RANDOM INITIAL DISPLACEMENTS, by W. E. Boyce. [1960] [16]p. incl. diagrs. (AFOSR-TN-60-150) (AF 18(600)1586) AD 233299; PB 145863 Unclassified

Also published in Jour. Aero/Space Sci., v. 28: 308-312; 320, Apr. 1961.

Elementary column buckling theory assumes the column is initially straight, and leads to an eigenvalue problem for the buckling load. For curved columns, the phenomenon of buckling disappears, inasmuch as nonzero displacements occur for arbitrarily small loads. The relation between the load and the mean transverse displacement of the column is discussed when the initial configuration of the column is random in nature. (Contractor's abstract)

2345

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

VIBRATIONS OF ROTATING BEAMS WITH TIP MASS, by W. E. Boyce and G. H. Handelman. [1960] [24]p. incl. diagrs. [Math. rept. no. 39] (AFOSR-TN-60-1402) (AF 18(600)1586) AD 247710; PB 153501 Unclassified

Also published in Zeitschr. Angew. Math. and Phys., v. 12: 369-392, 1961.

Several methods for obtaining approximate solutions to the eigenvalue problem posed by the transverse vibrations of a rotating beam carrying a tip mass are considered. These include asymptotic representations in terms of the rotational speed and upper and lower bound methods based on minimum principles. In the first case, explicit formulas are given for the first two terms and the lowest eigenvalue is determined to within quadratures which depend only on the section properties. Higher frequencies are explicitly calculated for the uniform beam as well as upper and lower bounds on the second frequency. Results show that for high rotational speeds and general section properties, the lowest frequency decreases as the tip mass is increased; whereas, for sufficiently high modes, the frequency increases with the tip mass. In the case of the uniform beam, upper and lower bound analyses show that the latter statement is true even for the second mode. (Contractor's abstract)

2346

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

ANALYSIS OF DYNAMIC EFFECTS OF ADDED MASS AND INITIAL STRESSES TO ELASTIC SYSTEMS, by G. H. Handelman and W. E. Boyce. Final rept. Nov. 25, 1960 [11]p. (Math. rept. no. 38) (AFOSR-373) (AF 18-(600)1586) Unclassified

It was found that the behavior of the frequency of vibration in elastic systems depended upon such parameters as ratios of the dimensions and density of the added mass to those of the unloaded system. If the relative density of the mass added to a membrane is fixed and its relative size is allowed to increase, the frequency may first decrease, due to greater influence of the mass on the kinetic energy, and later increase beyond its original value, due to eventual greater influence of the mass on the potential energy of the system. The vibrations of rotating twisted beams in which centrifugal forces provide the initial stresses, are also discussed in addition to the vibrations and stability of cantilevered beams subjected to a nonuniform axial stress. It was found that the mass depresses the lowest frequency, but for sufficiently large rotational speeds and sufficiently high modes of vibration, the opposite is the case. For beams of constant section the frequency is raised by the added mass even in the second mode, provided the speed of rotation is sufficiently great. Statistical information about the load-central displacement relation is derived as the basis of certain assumptions about the random initial displacement. The analysis proceeds from the solution of the pertinent boundary value problem in terms of a Green's function.

2347

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

LATERAL VIBRATIONS OF A BEAM UNDER INITIAL LINEAR AXIAL STRESS, by Y.-O. Tu and G. [H.] Handelman. [1960] [19]p. incl. tables. (AFOSR-J354) (AF 18(600)1586) AD 408029 Unclassified

Also published in Jour. Soc. Indust. Appl. Math., v. 9: 455-473, Sept. 1961.

Various approximate techniques in the solution of eigenvalue problems which describe either the vibrations or static stability of a beam under initial linear stress are considered. Standard perturbation techniques are discussed where the solution for the problem without initial stress is available. In the cases of very large initial stresses, perturbation techniques can be developed but the results are in the form of asymptotic expansions. Higher order terms in perturbation expansions are frequently tedious to calculate and it is rarely possible to state a priori in which direction the error lies. On the other hand, the associated minimum principles, particularly the Rayleigh quotients, yield upper bounds. Comparison theorems, based on Courant's maximum-minimum theorem, will give lower bounds for eigenvalues. In addition, Southwell's method frequently leads to very close lower bounds for the first eigenvalue. This method is only directly applicable to positive definite differential operators which, unfortunately, do not arise in problems where a critical value of the initial stress exists. It is seen that the perturbation solutions for small γ^2 are fairly good for $a \geq 0$, since then the values of γ^2 ($\gamma^2 = \gamma c^2$) are actually small. On the other hand, the singular perturbation method approximates the solution for large γ. In the particular case $a = -2$, most of the numerical values of the singular perturbation solution lies within bounds for the corresponding eigenvalue. Therefore, the asymptotic solution approximately represents the solution even for values of γ which are only moderately large. The Schwarz iteration, using very crude admissible functions gives very narrow gaps for small γ^2 and then deviates considerably as γ^2 increases. Better bounds could be expected if the iterations were carried farther and large scale computing machines were used instead of a desk calculator.

2348

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

PERIODIC RESPONSES AND SUPERPOSITION IN A NONLINEAR CONTROL SYSTEM, by B. A. Fleishman. May 19, 1960 [22]p. incl. diagr. (Math. rept. no. 34) (AFOSR-TN-60-477) (AF 49(638)514) AD 242189; PB 150262 Unclassified

Also published in Jour. Math. Anal. and Appl., v. 5: 306-315, Oct. 1962.

A simple relay servomechanism (or on-off control system) is subjected to arbitrary periodic input signals, and various periodic responses are studied. Two types of results are obtained: (1) exact analytical expressions for periodic responses, of harmonic and subharmonic type, are derived in a formal manner, and conditions are established for their validity; and (2) it is shown that for certain classes of periodic inputs various superposition properties hold. The average of the periodic responses to a set of inputs is shown to be just the response to the average input. It is thus seen that on-off control systems may display both nonlinear features (subharmonic oscillations) and linear features (superposition). (Contractor's abstract)

2349

Rensselaer Polytechnic Inst. [Dept. of Mathematics, Troy, N. Y.].

A COMPUTING PROCEDURE FOR QUANTIFICATION THEORY, by M. Davis and H. Putnam. [1959] [15]p. (AF 49(638)527) Unclassified

Published in Jour. Assoc. Comput. Mach., v. 7: 201-215, July 1960.

A computational procedure is outlined which when applied to logically valid formulas terminates and yields a proof of the validity of the formula. For formulas which are not logically valid, the computation continues indefinitely without giving a result.

2350

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

THE DECISION PROBLEM FOR EXPONENTIAL DIOPHANTINE EQUATIONS, by M. Davis, H. Putnam, and J. Robinson. [1960] [12]p. (AF 49(638)527) Unclassified

Published in Ann. Math., v. 74: 425-436, Nov. 1961.

It is proven that every recursively enumerable set can be existentially defined in terms of exponentiation. Hence, there is no general algorithm for deciding whether or not an exponential diophantine equation has a solution in positive integers. A general theorem about bounds for solutions of diophantine equations with a finite number of solutions is also obtained.

2351

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

EXPERIMENTAL INVESTIGATIONS OF ELECTROMAGNETICALLY INDUCED DETONATIONS. PART I. PARAMETERS AFFECTING THE FORMATION OF THE PINCH, by T. Donner and L. Aronowitz. Nov. 1959 [33]p. incl. illus. diagrs. tables. (PPL rept. no. 122) (AFOSR-TN-60-59) (AF 49(638)552) AD 232820; PB 145843 Unclassified

A series of tests were conducted with various gases to investigate the conditions needed for the formation of the pinch discharge. Most tests were conducted at capacitor energies somewhat below those under which pinches were previously obtained. Some tests were made with mixtures of H_2 and O_2 as a first attempt to obtain pinch induced detonations. The results indicate that pressure, the type of gas, and the energy in the capacitors discharged through the gas, affect the type of discharge. The various types of discharges that were obtained were classified according to their appearance on streak photographs. It was not established whether pinch induced detonations were obtained with the combustible mixtures tested. (Contractor's abstract)

2352

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

THEORETICAL STUDIES FOR A PROBLEM IN ELECTROMAGNETICALLY INDUCED DETONATIONS, by W. Chinitz, K. M. Foreman, and L. W. Levin. Nov. 30, 1959 [79]p. incl. diagrs. tables, refs. (PPL rept. no. 121) (AFOSR-TN-60-85) (AF 49(638)552) AD 232834; PB 145842 Unclassified

The aerothermochemistry of electromagnetically driven gaseous detonations is formulated, initially, as a standing free detonation problem. Next, the revisions necessary to transpose to a moving forced detonation, supported by a magnetic piston, are detailed. The numerical approximation techniques to permit programming for automatic digital computers are discussed. A method of computing enthalpy, heat of formation and equilibrium constant from available data is outlined. These 3 quantities are tabulated for 16 reactions, involving H, O, N, and Ar, between temperatures of 100° to 24,000°K. The results of a parametric study of standing oxy-hydrogen and air-hydrogen detonations are graphically presented and discussed. (Contractor's abstract)

2353

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

SOME ENGINEERING ASPECTS OF THE MAGNETOHYDRODYNAMIC PINCH PROCESS FOR SPACE PROPULSION, by I. Granet and W. J. Guman. Nov. 1959, 41p. incl. diagrs. refs. (PPL rept. no. 120) (AFOSR-TN-60-86) (AF 49(638)552) AD 232830; PB 145841 Unclassified

A method of utilizing the electromagnetic pinch for propulsion is discussed. A description is given of several analytical models currently in use to describe the pinch process, the approximations contained in each, and their limitations. Based upon conclusions drawn, the snow plow method was selected for a systematic analysis of a propulsion system with various combinations of the input parameters. The coupled governing differential equations are given and the results of an IBM 704 computer program are analyzed. Based upon momentum considerations, a generalized correlation is proposed and tested against the calculations and available experimental data. Conclusions based upon the analytical, computational and experimental work are given and some comparison is made with work reported in the current technical literature.

2354

Republic Aviation Corp. [Plasma Propulsion Lab.] Farmingdale, N. Y.

THIRD AFOSR CONTRACTORS' MEETING ON ION AND

PLASMA PROPULSION, Farmingdale, N. Y., Mar. 22-24, 1960. [1960] 1v. (AFOSR-TN-60-405) (AF 49(638)-552) AD 235949; PB 146900 Unclassified

This report contains 35 abstracts of papers presented at the meeting. The subjects discussed are: electromagnetic pinch research; development of an ion engine; preliminary design of an integrated space vehicle propulsion system; ion propulsion; charged colloid propulsion; surface emission of positive ions; micron size particles for electric propulsion; compact charge ionization; heavy particle propulsion; ion in rocket combustion; heat transfer from arc heated gases; electromagnetic plasma propulsion studies; design studies on the XE-701 ion engine; investigation of ion thrust devices; initial ionization process in gases; small plasma jet propulsors; high intensity plasma jets, acceleration in channeling of plasma jets by magnetic fields; pulsed plasma propulsion; aerodynamic applications of plasma wind tunnels; studies on propulsion of plasma; plasma acceleration by non-uniform RF fields; crossed field acceleration of ions and plasmas; injection into a linear plasma accelerator; high temperature magnetohydrodynamic experiments; realization of magnetohydrodynamic propulsion; continuous magnetic acceleration of arc plasma; low temperature plasma jet; thermophysical properties of magnetohydrodynamic plasmas; magnetohydrodynamic waves; gasdynamics of plasma; heat transfer from an ionized gas to a gaseous coolant; Cs solid propellant; properties of ions in flames; and ion rocket sputtering and neutralization studies.

2355

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

POWER SUPPLY DESIGN PARAMETER STUDY FOR ELECTROMAGNETIC DETONATIONS (PHASE I), by K. M. Foreman. Aug. 31, 1960, 17p. incl. diagrs. (Rept. no. PPL-TR-60-3) (AFOSR-TN-60-1198) (AF 49(638)552) AD 245690; PB 152955 Unclassified

The characteristics of an electrical power supply suitable for electromagnetically induced detonations are indicated. A parametric study of circuit constants for a single simple R-L-C series circuit shows that this type of power supply is inadequate to provide for all requirements of a propulsion device. However, a suitable pulse of current for laboratory demonstration purposes can be achieved with the following typical circuit constants: $L = 10^{-8}$ henries, $C = 3 \times 10^{-5}$ farads, and $R = 10^{-2}$ ohms. (Contractor's abstract)

2356

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

THE EFFECT OF VARIABLE PLASMA CONDUCTIVITY ON MHD ENERGY CONVERTER PERFORMANCE, by W. B. Coe and C. L. Eisen. Oct. 1960, 20p. incl. diagrs. (Rept. no. PPL-TR-60-16(176) (AFOSR-TN-60-1439) (AF 49(638)552) AD 254674; PB 155791 Unclassified

Presented at Pacific general meeting of the Amer. Inst. Elec. Engineers, San Diego, Calif., Aug. 8-12, 1960.

Also published in Trans. Amer. Inst. Elec. Engineers, v. 80(Pt. II): 225-231, Nov. 1961.

The results of a performance study of a constant area channel in which the electrical conductivity of the plasma is dependent on its local thermodynamic properties are presented. The required entrance flow Mach number for maximum power density increases as the entrance stagnation temperature is increased. For the temperature range of immediate interest (2000°K-5000°K) the required entrance Mach number is always subsonic. In the construction of an actual MHD energy converter, the subsonic Mach number requirement permits more flexibility in the design, and lends more validity to the approximation made in the analysis than would be true for a supersonic energy converter. The attainable power density increases sharply with increases in entrance stagnation temperature. Since the maximum temperature at which an MHD energy converter can operate is limited by the capabilities of the materials involved, the reward of large increases in performance for small increases in operating temperatures provides a strong incentive for sophistication in design and for the accomplishment of even small increases in materials capability. (Contractor's abstract)

2357

Republic Aviation Corp. [Plasma Propulsion Lab.] Farmingdale, N. Y.

AN ANALYTICAL APPROACH TO THE PROBLEM OF PINCH DYNAMICS, by B.-T. Chu. Nov. 1960, 27p. (Rept. no. PPL-TR-60-9(185)) (AFOSR-19) (AF 49-(638)552) AD 252112 Unclassified

The motion of a gas between 2 parallel circular electrodes during the pinch process is analyzed from the fluid dynamical viewpoint. The solution is presented in the form of a double-series expansion, the first term of which agrees with that deduced from the snow plow model. The higher-order terms in the expansion give a detailed description of the motion of the gas between the advancing shock and the current sheath. (Contractor's abstract)

2358

Republic Aviation Corp. [Plasma Propulsion Lab.] Farmingdale, N. Y.

A DC GLOW MODEL OF THE FORMATION OF THE MAGNETIC PISTON, by L. Aronowitz and P. [M.] Mostov.

Dec. 1960, 12p. incl. illus. (Rept. no. PPL-TR-60-21 (241)) (AFOSR-319) (AF 49(638)552) AD 252393; PB 155211 Unclassified

The formation of the magnetic sheath or magnetic piston in a linear pinch discharge between metal electrodes is often analyzed by methods that ignore the role of the electrodes. However, in many regimes of practical interest, electrode effects may play a dominant role. The results of dc discharge phenomena are incorporated to account for these electrode effects. A method is developed to compute current density as a function of position and time in the early stages of a pinch discharge. (Contractor's abstract)

2359

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

ANALYSIS OF A PLASMA ACCELERATOR, INCLUDING RESISTIVE EFFECTS AND MODE-SWITCHING (Abstract), by P. M. Mostov, J. L. Neuringer, and D. S. Rigney. [1959] [1]p. [AF 49(638)552] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Dec. 3-5, 1959.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 325, Apr. 25, 1960.

A pulsed plasma accelerator is analyzed. The slug model is emphasized. Employing a constant source resistance R_0, and a variable wall resistance whose gradient R_1 is later specified constant, a system of coupled nonlinear equations involving 7 parameters are derived and transformed into a 3-parameter set. This formulation provides a more realistic bases than, and includes as special cases, Artsimovitch's treatment ($R_0 = R_1 = 0$), and Schock's approximate periodic mode treatment ($R_1 = 0$) which is valid in many cases after 1/2 cycle. Wide ranges of operating conditions and parameters are considered. Curves of plasma position, velocity, efficiency ϵ, utilization factor η voltage, current, and frequency are given. Periodic and aperiodic modes, as well as mode-switching and switch-backs during the acceleration, are possible. Criteria are given. In one typical case, including R_0 lowers the ultimate ϵ from an unrealistic 100% implied by $R_0 = R_1 = 30\%$; including R_1 further lowers ϵ by 25%. Optimum cutoffs are discussed. η's almost equal to the highest obtainable in a particular case frequently can be achieved with practical lengths by terminating at local peaks.

2360

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

THE MAGNETIC PINCH ENGINE FOR SPACE FLIGHT, by A. E. Kunen and W. McIlroy. [1960] [13]p. incl. illus. diagrs. tables. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)552 and Office of Naval Research under Nonr-2851(00)) Unclassified

Presented at Second western nat'l. meeting of the Amer. Astronaut. Soc., Los Angeles, Calif., Aug. 4-5, 1959.

Published in Advances in Astronaut. Sci., v. 5: 166-178, 1960.

The electromagnetic pinch effect, familiar to fusion research, may be adapted to accelerate ionized gas for space propulsion and satellite control. On discharging capacitors between 2 nozzle-shaped electrodes, the current-carrying skin can be made to drive the gases axially outwards from the chamber. For a sufficiently high gas density the mechanism is treated as a solid magnetic piston driving a shock wave ahead of it into the gas. Different electrode designs were investigated experimentally and theoretically and the results compared. The results of an investigation into a 1-way unmanned flight from an Earth orbit to a Mars orbit are presented. In addition the relationship between total weight/thrust and specific impulse, pulsating rate, weight of generating equipment, etc., was derived, and from these calculations conclusions were drawn regarding the optimum operating conditions for specific missions. (Contractor's abstract)

2361

RIAS, Inc., Baltimore, Md.

SOME EXTENSIONS OF LIAPUNOV'S SECOND METHOD, by J. P. LaSalle. [1960] [36]p. incl. diagrs. (Technical rept. no. 60-5) (AFOSR-TN-60-22) (AF 49-(638)382) AD 233805 Unclassified

Also published in I.R.E. Trans. on Circuit Theory, v. CT-7: 520-527, Dec. 1960.

In studying the stability of a system, it is not enough to know that an equilibrium state is asymptotically stable. It is also necessary to have some idea of the size of the perturbations the system can undergo and still return to the equilibrium state. This cannot be accomplished by examining only the linear approximation. The effect of the nonlinearities must be taken into account. Liapunov's second method provides a means of doing this. Mathematical theorems underlying methods for determining the region of asymptotic stability are given, and the methods are illustrated by a number of examples. (Contractor's abstract, modified)

2362

RIAS, Inc., Baltimore, Md.

THE EXTENT OF ASYMPTOTIC STABILITY, by J. P. LaSalle. [1960] [3]p. (AFOSR-TN-60-56) (AF 49(638)-382) Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 46: 363-365, Mar. 1960.

In studying the stability of a system, it is necessary, from the practical point of view, to have some idea of the region of asymptotic stability. Some theorems related to this problem are given. Consider the system (1) $x = X(x)$, where x, X are n-vectors, and where for each x^0 there exists a unique solution $x(t,x^0)$ of (1) with $x(0,x^0) = x^0$ and this solution depends continuously on x^0. Theorem 1: Let Ω be a bounded closed set such that $x^0 \in \Omega$ implies $x(t,x^0) \in \Omega$, $t \geq 0$. Suppose there exists a scalar function $V(x)$ such that $\dot{V}(x) = (\text{grad}V)\cdot X \leq 0$ in Ω. Let E be the set of points in Ω with $\dot{V}(x) = 0$ and let M be the largest invariant set in E. Then every solution starting in Ω approaches M as $t \to \infty$. Two other theorems are given. One deals with the case when the set Ω can be constructed from V(x) and the other gives conditions for the stability in the large set M above. The proofs are to appear elsewhere.

2363

RIAS, Inc., Baltimore, Md.

FORCED OSCILLATIONS IN 3-SPACE, by C. Coleman. Feb. 1960 [10]p. (Technical rept. no. 60-4) (AFOSR-TN-60-57) (AF 49(638)382) AD 233807; PB 146431 Unclassified

Presented at Mexico City Symposium (Mexico), June 1960.

The system $dx/dt = f(x,t) = G(x,t,\lambda)$ is shown to have a solution of period 1, a forced oscillation if f,g,λ and n satisfy certain conditions, where x is an n-vector, λ a real parameter, and $f(x,t)$ and $g(x,t,\lambda)$ n-vector functions of period 1 in t. The case $\lambda = o, n = 3$ is studied. The basic idea is an extension to 3-space of Cronin's methods. Section 2 contains the main theorems and some explanatory remarks. The last section is devoted to some examples.

2364

RIAS, Inc., Baltimore, Md.

EXISTENCE THEOREMS FOR PERIODIC SOLUTIONS OF NONLINEAR DIFFERENTIAL SYSTEMS, by L. Cesari. Mar. 1960, 30p. incl. refs. (Technical rept. no. 60-8) (AFOSR-TN-60-227) (AF 49(638)382) AD 236445; PB 147317 Unclassified

Presented at Symposium on Ordinary Differential Equations, Mexico City, Sept. 1960.

Also published in Bol. Soc. Math. Mexicana, Series II, v. 5: 24-41, 1960.

An approach to existence theorems for periodic solutions of nonlinear differential systems is given. A number of applications and results are summarized. The technique is a development by the author, J. K. Hale, R. A. Gambill, W. R. Fuller et al. A more general presentation is made with the applications and results under consideration belonging to the class of the problems of perturbation of linear differential systems.

2365

RIAS, Inc., Baltimore, Md

ON AUTOMATIC CONTROLS, by S. Lefschetz. Mar. 1960, 6p. (Technical rept. no. 60-9) (AFOSR-TN-60-230) (AF 49(638)382) AD 277139; PB 147318 Unclassified

Also published in I.R.E. Trans. on Circuit Theory, v. CT-7: 474-475, Dec. 1960.

The nonlinearity of the regulated system is treated and certain consequences of this nonlinearity are made clear The Liapunov theorem states that if: (a) no solution leaves the closed and bounded set Ω; (b) there exists a Liapunov function V(x) over Ω such that -V is one likewise then the origin is asymptotically stable and Ω is contained in the region of asymptotic stability. The theorem is used to show that a suitable control enlarges the region of asymptotic stability.

2366

RIAS, Inc., Baltimore, Md.

ULTIMATE BOUNDEDNESS AND STABILITY UNDER PERTURBATIONS, by P. Seibert. Mar. 1960 [16]p. (Technical rept. no. 60-7) (AFOSR-TN-60-231) (AF 49-(638)382) AD 236446; PB 147316 Unclassified

Presented at Symposium on Ordinary Differential Equations, Mexico City, Sept. 1960.

The preservation of ultimate boundedness of a dynamical system under perturbations is considered. The results are centered around a general principle, according to which the motions of the unperturbed and of a perturbed system with the same initial point remain within a certain fixed maximal distance from each other for all time, if they do so for a small length of time and if, in addition, the unperturbed system is ultimately bounded. This result is then applied to the problem of perservation of stability under perturbations and a necessary and sufficient condition for the latter is obtained. (Contractor's abstract)

2367

RIAS, Inc., Baltimore, Md.

PIECEWISE CONTINUOUS DIFFERENTIAL EQUATIONS, by J. André and F. Seibert. Mar. 1960, 6p. (Technical rept. no. 60-6) (AFOSR-TN-60-232) (AF 49(638)382) AD 236447; PB 147315 Unclassified

Presented at Symposium on Ordinary Differential Equations, Mexico City, Sept. 1960.

Also published in Bol. Soc. Math. Mexicana, Series II, v. 5: 242-245, 1960.

A brief survey of the local properties of solutions of systems of piecewise continuous differential equations near the surfaces of discontinuity is given. Properties of the corresponding systems with retardation [time-lag, switching delay] are discussed with emphasis on the after-endpoint motions. (Contractor's abstract)

2368

RIAS, Inc., Baltimore, Md.

ON THE METHOD OF AVERAGING, by J. K. Hale. May 1960 [11]p. (Technical rept. no. 60-13) (AFOSR-TN-60-270) (AF 49(638)382) AD 238404; PB 148658 Unclassified

Also published in I.R.E. Trans. on Circuit Theory, v. CT-7: 517-519, Dec. 1960.

The method of averaging of van der Pol was devised to obtain periodic and almost periodic solutions of quasi-linear systems of differential equations. A theorem is stated for a particular case where the method has been justified mathematically and an example is given to illustrate the results. (Contractor's abstract)

2369

RIAS, Inc., Baltimore, Md.

AUTOSYNARTETIC SOLUTIONS OF DIFFERENTIAL EQUATIONS, by D. C. Lewis. May 1960, 57p. (Technical rept. no. 60-12) (AFOSR-TN-60-438) (AF 49-(638)382) PB 148014 Unclassified

Also published in Amer. Jour. Math., v. 83: 1-32, Jan. 1961.

Consider the differential system $dx/dt = f(t,x)$, where x and f are n-vectors and t is the scalar variable, $f \in C'$, in a suitably chosen region. Suppose that this system is carried into itself by the transformation $s = P(t,x)$, $y = h(t,x)$. (P is a scalar and h a vector, both of class C'.) The solution $x(t)$ of the system, satisfying the functional equation $x(P(t,x(t))) = h(T,x(t))$ is called autosynartetic. The main features are shown of Poincaré's theory to a parameter may be extended to cover the perturbation of such a solution. Some theorems are given about the degeneracy of an autosynartetic solution, about associated so-called bifurcation equations, about the influence of certain kinds of first integrals on the degeneracy and on the bifurcation equations.

2370

RIAS, Inc., Baltimore, Md.

ON CERTAIN NON-LINEAR OPERATORS AND PARTIAL DIFFERENTIAL EQUATIONS, by G. I. Heller. May 1960, 77p. (Technical rept. no. 60-14) (AFOSR-TN-60-474) (AF 49(638)382) AD 239118; PB 148659 Unclassified

Also published in Pacific Jour. Math., v. 11: 495-529, 1961.

The results of Lewis (Trans. Amer. Math. Soc., v. 35: 792-823, 1933) for second-order differential equations are generalized by applying his method in operators in Hilbert space. Lewis constructed a system of solutions $X_n(t)$ of the infinite system of ordinary differential equations $\Phi_n(t, X_1(t), dX_1/dt, \ldots, d^kX_1/dt^k, X_2(t), \ldots) = 0$ with boundary conditions $\left.\frac{d^1X_n}{dt^1}\right|_{t=0} = \frac{2}{\pi}\int_0^\pi f(y)\sin(ny)\,dy$, corresponding to the second-order differential equations of the form $\frac{\partial^2 u}{\partial t^2} - \frac{\partial^2 u}{\partial y^2} = \varphi(\partial u/\partial t, \partial u/\partial y, u, y, t)$ with the boundary conditions $u(0,t) = u(\pi,t) = 0$, $u(y,0) = f(y)$, and $\left.\frac{\partial u}{\partial t}\right|_{t=0} = g(y)$. Also proved was that the function $u(y,t) \sum_{n=1}^{\infty} X_n(t)\sin(ny)$ is a solution of the second-order differential equations. Some results are established concerning solution of the equation $Tu = 0$, where T is a (non-linear) operator in Hilbert space. T is of the form $T = L - SN$, where L and N are linear, and S satisfies a Lipschitz condition. As applications, Lewis' theorem and some existence theorems for non-linear higher order partial differential equations are presented.

2371

RIAS, Inc., Baltimore, Md.

STABILITY AND BOUNDEDNESS OF SYSTEMS, by T. Yoshizawa. [1960] [13]p. (Monograph no. 61-2) (AFOSR-TN-60-767) (AF 49(638)382) AD 253577 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 6: 409-421, 1960.

Concepts in the theory of stability concerning the behavior of the solutions relative to a fixed solution and problems in the theory of boundedness concerning the

norms of solutions are discussed relative to an arbitrary solution of the system and their relationships with the Liapunov function. A system of differential equations $dx/dt = F(t,x)$ is studied where x denotes an n-dimensional vector and $F(t,x)$ is a given vector field which is defined and continuous in the product space I X E I X E_x^n, wnere I is the interval $0 \leq t < \infty$ and E_x^n is Euclidean n-space. Let $x = x(t; x_0, t_0)$ be a solution of $dx/dt = F(t,x)$ through the initial point (t_0, x_0). The Euclidean norm of x is represented by $\|x\|$.

2372

RIAS, Inc., Baltimore, Md.

POTENTIAL FORCES WHICH YIELD PERIODIC MOTIONS OF A FIXED PERIOD, by M. Urabe. [1960] [10]p. (AFOSR-TN-60-768) [AF 49(638)382] Unclassified

Also published in Jour. Math. and Mech., v. 10: 569-578, July 1961.

The case where the period of each periodic solution is independent of its amplitude is considered. It is shown that the function g(x), for which the equation

$$\frac{d^2x}{dt^2} + g(x) = 0$$

admits of a family of periodic solutions of a constant period, has considerable arbitrariness.

2373

RIAS, Inc., Baltimore, Md.

SIMPLE CURVES ON COMPACT SURFACES, by B. L. Reinhart. [1960] [2]p. (AFOSR-TN-60-933) (In cooperation with Maryland U., College Park) (AF 49(638)382) AD 247208 Unclassified

Published in Proc. Nat'l. Acad. Sci., v. 46: 1242-1243, Sept. 1960.

Let M be a compact oriented surface of genus p at least 2. Given any word W in the usual generators of π_1 (M, x'), an algorithm is given for determining whether the free homotopy class to which this work belongs admits a simple closed curve. This is studied by considering (1) the canonical representation of M as a 4p sided polygon, and let D be a polygonal disk about the base point, and let W be a word such that no subword represents the identity in π_1; and (2) M as a surface of constant negative curvature, and let p: H → M be the covering map of the hyperbolic plane onto M.

2374

RIAS, Inc., Baltimore, Md.

CONDITIONS FOR THE STABILITY OF NONAUTONOMOUS DIFFERENTIAL EQUATIONS, by J. K. Hale and A. P. Stokes. [1960] [20]p. incl. table. (AFOSR-TN-60-1022) (AF 49(638)382) Unclassified

Also published in Jour. Math. Anal. and Appl., v. 3: 50-69, Aug. 1961.

The asymptotic stability of nonautonomous systems of differential equations, both linear and nonlinear, is considered. The real system of equations $dx/dt = B(t)x$, $t \geq 0$, is considered where x is an n vector. The asymyptotic stability problem is approached by assuming that the eigenvalue of B(t) have real parts bounded by $-gt^{\beta}$, where $\beta > -1$ and $g > 0$. Nonlinear systems of the form $dx/dt = A(t)x + f(t,x)$ are studied and conditions are given under which the origin is asymptotically stable, including cases in which the eigen-values of A(t) approach zero as $t \to \infty$ and $\|f(t,x)\| \to \infty$ for $x \neq 0$ and fixed. The knowledge of the behavior of the system over the interval for all large t allows a conclusion to be formed on the behavior of the system for all $t \geq 0$. An application to differential-difference equations with nonconstant coefficient is given, using an integral equation of Bellman and Cooke (Trans. Amer. Math. Soc., v. 92: 470-500, 1959) to represent the solutions of the differential-difference equation.

2375

RIAS, Inc., Baltimore, Md.

REVERSIBLE TRANSFORMATIONS, by D. C. Lewis, Jr. [1960] [8]p. (Technical rept. no 60-16) (AFOSR-TN-60-1035) (AF 49(638)382) AD 247231; PB 153412 Unclassified

Also published in Pacific Jour. Math., v. 11: 1077-1087, 1961.

A non-singular transformation T of a space S into itself is said to be reversible if there is a non-singular transformation U such that $T^{-1} = UTU^{-1}$. Where U is involutory, i.e. $U^{-1} = U$, one may write (UT)(UT) = I where I is the identity. The question posed by Birkhoff as to whether T may be written in the form UVU*V is answered in the affirmative (without using $U = U^{-1}$). The special cases of Theorem 1, where $W = UT^h$, h = o and h = 1, furnish versions of similar theorems implicitly given in the joint paper with Lipschitz. Theorem 2 is a more symmetrical but weakened form of theorem 1. Theorem 3 shows a further connection between Birkhoff's original theorems and the generalizations of this paper.

2376

RIAS, Inc., Baltimore, Md.

CLOSED METRIC FOLIATIONS, by B. L. Reinhart. Sept. 1960 [5]p. (Technical rept. no. 60-17) (AFOSR-TN-60-1039) (AF 49(638)382) AD 247232; PB 153413 Unclassified

Also published in Michigan Math. Jour., v. 8: 7-8, 1961.

The case where all leaves are closed subsets of M is considered, with M, a C_n^{∞} dimensional manifold with a p dimensional foliation F and a fibre-like Riemannian ds. M is said to have a closed metric foliation. The quotient space B = M/F is the space formed from M by identifying each leaf to a point, and π: M → B is the identification map. If L is a leaf, H(L) is the holonomy group of L. The concept of V fibre space is introduced by dropping the structural group from the definition of V bundle. $\{U,G,\Phi\}$ is used to signify a local uniformizing structure on an open set in the V manifold B, λ to signify an injection $\{U,G,\Phi\} \rightarrow \{U',G',\Phi'\}$, and h_U signifies an anti-isomorphism of G into a group of fibre mappings of a fibre space B_U over U onto itself. The structure of a metric foliation in the neighborhood of a leaf is discussed globally.

2377

RIAS, Inc., Baltimore, Md.

EXISTENCE OF A BOUNDED SOLUTION AND EXISTENCE OF A PERIODIC SOLUTION OF THE DIFFERENTIAL EQUATION OF THE SECOND ORDER, by T. Yoshizawa. [1960] [13]p. (Technical rept. no. 60-18) (AFOSR-TN-60-1064) (AF 49(638)382) AD 247233; PB 153414 Unclassified

Also published in Mem. Coll. Sci., Kyoto U. Series A, v. 33: 301-318, 1960/61.

The existence of a bounded solution for a differential equation of the second order $x'' = F(t,x,x')$ where $F(t,x,x')$ is periodic in t, is discussed. An application is made to the existence of a periodic solution. Theorem 1 is proved: Suppose that two functions $\bar{\omega}(t)$ and $\underline{\omega}(t)$ are defined on I, twice differentiable and bounded on I with their derivatives and satisfy the inequalities $\underline{\omega}(t) \leq \bar{\omega}(t)$; $\bar{\omega}''(t) \leq F(t,\bar{\omega}(t), \bar{\omega}'(t))$; $\underline{\omega}''(t) \geq F(t,\underline{\omega}(t), \underline{\omega}'(t))$. With the assumption of several other auxiliary conditions, the general second order equation has a bounded solution, i.e., a solution x(t) such that $x(t)^2 + x'(t)^2$ is bounded for all $t \geq t_0$.

2378

RIAS, Inc., Baltimore, Md.

ALGORITHMS FOR JORDAN CURVES ON COMPACT SURFACES, by B. L. Reinhart. Nov. 1960 [20]p. incl. refs. (Technical rept. no. 60-21) (AFOSR-TN-60-1123) (AF 49(638)382) AD 248305; PB 153710 Unclassified

Also published in Ann. Math., v. 75: 209-222, Mar. 1962.

An algorithm is given for determining which free homotopy classes admit a simple closed Jordan curve in the use of compact surfaces of negative Euler number. The problem is treated globally by imbedding the fundamental group into the group of motions of the hyperbolic plane in the manner of Poincaré and Nielsen. The preliminary method assigns to each word in the usual generators of the fundamental group a curve on the surface which has double points only in the neighborhood of the base point and no other multiple points and applies the fact that each motion of the hyperbolic plane which arises in our problem leaves fixed a unique geodesic, its axis.

2379

RIAS, Inc., Baltimore, Md.

LOCAL LINEAR DEPENDENCE AND THE VANISHING OF THE WRONSKIAN, by G. H. Meisters. Nov. 1960 [18]p. incl. refs. (Technical rept. no. 60-22) (AFOSR-TN-60-1213) (AF 49(638)382) AD 248304 Unclassified

Also published in Amer. Math. Monthly, v. 68: 847-856, 1961.

The sufficiency condition in the statement that "A necessary and sufficient condition that n functions $f_1,\cdots,f_n$ be linearly dependent on an interval I is that their Wronskian determinant vanish identically on I" does not hold for n functions which are only (n-i)-times differentiable. A dependence relation weaker than linear dependence and called "local linear dependence" is developed for real variably n functions which are (n-1)-times differentiable. It is shown that local linear dependence and the identical vanishing of the Wronskian are equivalent in the class of infinitely differentiable functions.

2380

RIAS, Inc., Baltimore, Md.

NEW RESULTS IN LINEAR FILTERING AND PREDICTION THEORY, by R. E. Kalman and R. S. Bucy. [1960] [14]p. incl. diagrs. refs. (Monograph no. 61-8) (AFOSR-835) (Sponsored jointly by Air Force under AF 33(616)-6952, Air Force Office of Scientific Research under AF 49(638)382, and Bureau of Naval Weapons under NOrd-73861) AD 256288 Unclassifie'

Presented at Joint Automatic Controls Conf., Cambridge, Mass., Sept. 7-9, 1960.

Also published in Jour. Basic Eng., v. 83: 95-108, 1961.

A nonlinear differential equation of the Riccati type is derived for the convariance matrix of the optimal filtering error. The solution of this variance equation completely specifies the optimal filter for either finite or infinite smoothing intervals and stationary or nonstationary statistics. The variance equation is closely related to the Hamiltonian (canonical) differential equations of the calculus of variations. Analytic solutions are available in some cases. The significance of the variance equation is illustrated by examples which duplicate, simplify, or extend earlier results in this field. The Duality principle relating stochastic estimation and deterministic control problems plays an important role in the proof of theoretical results. In several examples, the estimation problem and its dual are discussed side-by-side. Properties of the variance equation are of great interest in the theory of adaptive systems. Some aspects of this are considered briefly. (Contractor's abstract)

2381

RIAS, Inc., Baltimore, Md.

THE THEORY OF OPTIMAL CONTROL AND THE CALCULUS OF VARIATIONS, by R. E. Kalman. [1960] [32]p. incl. diagr. refs. (Technical rept. no. 61-3) (AFOSR-1121) (Sponsored jointly by Air Force under AF 33(616)6952 and Air Force Office of Scientific Research under AF 49(638)382) AD 267577
Unclassified

Also published in Mathematical Optimization Techniques; a Symposium, Santa Monica, Calif. (Oct. 18-20, 1960), Berkeley and Los Angeles, California U. Press, 1963, p. 309-331.

The Hamiltonian theory of the calculus of variations is formulated for a wide variety of problems in the theory of control. The Hamiltonian function is constructed with the aid of the Minimum Principle, which is the counterpart of the same principle due to Pontryagin. The canonical differential equations of Hamilton are shown to imply Pontryagin's theorem. A number of concrete examples are included. (Contractor's abstract)

2382

RIAS, Inc., Baltimore, Md.

NEW METHODS AND RESULTS IN LINEAR PREDICTION AND FILTERING THEORY, by R. E. Kalman. [1960] [159]p. incl. diagrs. refs. (Technical rept. no. 61-1) (AFOSR-1281) [AF 49(638)382] AD 262281 Unclassified

Also published in Proc. of the First Symposium on Engineering Applications of Random Function Theory and Probability, Purdue U., Lafayette, Ind. (Nov. 1960), New York, John Wiley and Sons, 1963, p. 270-388. (Title varies)

The Wiener problem is reduced to the classical Hamiltonian formalism of the calculus of variations. Many long-standing difficulties of the theory are resolved or greatly clarified. The solution consists in the specification of the differential equation of the optimal filter.

2383

[RIAS, Inc., Baltimore, Md.]

STRUCTURAL STABILITY IN THE PLANE WITH ENLARGED BOUNDARY CONDITIONS, by M. C. Peixoto and M. M. Peixoto. [1959] [35]p. incl. diagrs. refs. (AFOSR-2793) (AF 49(638)382) Unclassified

Also published in Anais Acad. Brasil. Cien., v. 31: 135-160, 1959.

Consider the class of differential equations $(X)\dot{x} = P(x,y)$, $\dot{y} = Q(x,y)$ with P, Q in C^1 in a neighborhood of G, a closed bounded plane region with a Jordan boundary curve L of class C^1. Using the C^1-norm in G, it is found that the set of all such differential systems is a Banach space $\mathfrak{B}$. A differential system X in $\mathfrak{B}$ satisfies the boundary condition B in case: (1) X has no critical point on L and no limit cycle tangent to L from inside G; (2) X has at most a finite number of points of tangency with L, and at each such point L the trajectories of X have distinct curvatures; (3) each trajectory of X which meets L is tangent to L at most once; and (4) no trajectory of X connecting L to a saddle point of X is tangent to L. A differential system X in $\mathfrak{B}$ is called structurally stable (in the wide sense) in case X satisfies B and also X is topologically equivalent to all neighboring members of $\mathfrak{B}$. It is proved that the set of structurally stable differential systems is open and dense in the metric space $\mathfrak{B}$. The proof follows a difficult construction which shows that X, satisfying B, is structurally stable if and only if the Andronov-Pontryagin conditions are fulfilled. (Math. Rev. abstract)

2384

RIAS, Inc., Baltimore, Md.

THE WINDING NUMBER ON TWO MANIFOLDS, by B. L. Reinhart. [1960] [13]p. (AFOSR-J1485) (AF 49(638)-382) AD 427534 Unclassified

Also published in Ann. Inst. Fourier (Grenoble), v. 10: 271-283, 1960.

The winding number technique has been excluded to get necessary conditions for the existence of a simple closed curve in a given regular homotopy class. The

winding number, or more precisely the winding homomorphism, for compact orientable two manifold is defined. It is a homomorphism from the regular homotopy group of M into the integers modulo x, where x is the Euler characteristic of M. The value of the winding homomorphism is computed for a regular simple closed curve, assuming its homotopy class (in the usual sense) is known. (Contractor's abstract)

2385

RIAS, Inc., Baltimore, Md.

CONTROL SYSTEM ANALYSIS AND DESIGN VIA THE "SECOND METHOD" OF LYAPUNOV. I. CONTINUOUS-TIME SYSTEMS, by R. E. Kalman and J. E. Bertram. [1960] [23]p. incl. diagrs. refs. (AF 49(638)-382) Unclassified

Published in Jour. Basic Engineering, v. 82: 371-393, June 1960.

The second method of Lyapunov is the most general approach currently in the theory of stability of dynamic systems. After a rigorous exposition of the fundamental concepts of this theory, applications are made to (1) stability of linear stationary, linear non-stationary, and nonlinear systems; (2) estimation of transient behavior; (3) control-system optimization; and (4) design of relay servos. The discussion is essentially self-contained, with emphasis on the thorough development of the principal ideas and mathematical tools. Only systems governed by differential equations are treated here. (Contractor's abstract)

2386

RIAS, Inc., Baltimore, Md.

CONTROL SYSTEM ANALYSIS AND DESIGN VIA THE "SECOND METHOD" OF LYAPUNOV. II. DISCRETE-TIME SYSTEMS, by R. E. Kalman and J. E. Bertram. [1960] [7]p. incl. refs. (AF 49(638)382) Unclassified

Published in Jour. Basic Engineering, v. 82: 394-400, June 1960.

The second method of Lyapunov is applied to the study of discrete-time (sampled-data) systems. Theorems are stated in full but motivation, proofs, and examples are given only when they differ materially from their counterparts in the continuous-time case (item no. 2385, Vol. IV). (Contractor's abstract)

2387

RIAS, Inc., Baltimore, Md.

ON THE GENERAL THEORY OF CONTROL SYSTEMS, by R. E. Kalman. [1960] [12]p. incl. diagrs. refs. (AF 49(638)382) Unclassified

Presented at the First Internat'l. Cong. of the Internat'l. Federation of Automatic Control, Moscow (U.S.S.R.), 1960.

Published in Automatic and Remote Control, v. 1: 481-492, 1960.

Restricting attention to linear, stationary, single input/single output plants, the new concepts of controllability and observability are introduced. It follows that solutions of the usual problems of control theory exist if and only if the plant is completely controllable and completely observable. The connection between observability and controllability is formalized by the Duality Principle, which shows that the Wiener filtering and prediction problem is a special case of the author's theory of optimization of deterministic control systems. (Contractor's abstract)

2388

RIAS, Inc., Baltimore, Md.

MATHEMATICAL LEGITIMACY OF EQUIVALENT LINEARIZATION BY DESCRIBING FUNCTIONS, by R. W. Bass. [1960] [11]p. incl. refs. (AF 49(638)382) Unclassified

Presented at the First Internat'l. Cong. of the Internat'l. Federation of Automatic Control, Moscow (U.S.S.R.), 1960.

Published in Automatic and Remote Control, v. 2: 895-905, 1960.

It has been assumed that describing functions have validity when the linear part of the system is a low band-pass filter or when the system's non-linearities are insensitive to the higher harmonics of any periodic input. It has been proven that these heuristic considerations are accurate, at least for smooth systems, when supplemented by consideration of the principal suffix and stated as follows: No member of the hypothetical family which connects the physical system and the hypothetical tractable system can exhibit a resonance in the sense of having periodic modes of arbitrarily small frequencies, or in the sense that the systems' principal suffix may depart from the suffix selected in application of the describing function method. Moreover, it is shown that the describing function method gives rigorously valid results for some discontinuous systems in which the π symmetric solutions have discontinuities only at half-periods.

2389

RIAS, Inc., Baltimore, Md.

METRIC TRANSITIVITY AND INTEGER-VALUED FUNCTIONS, by S. Schwartzman. [1960] [6]p. (AF 49-(638)382) Unclassified

Published in Ann. Inst. Fourier (Grenoble), v. 10: 297-302, 1960.

X is taken to be a measure space with measure μ satisfying $\mu(X) = 1$. φ is a measurable map of X onto itself such that $\mu(\varphi^{-1}(s)) = \mu(s)$ for every measurable set S. B denotes the additive group of bounded measurable integer-valued functions. Hp denotes the subset of B consisting of all functions f(x) in B such that $0 \leq f(x) \leq p-1$ for all x with the exception that the function is excluded which is identically equal to p-1 from Hp. The theorem given states that (1) φ is metrically transitive; (2) Every f(x) in B has a unique representation of the form $k + \alpha_0 + (2-T)\alpha_1 + \ldots + (2-T)^n\alpha_n$ where k is an integral constant, $\alpha_1 \in H_2$, and α_n is not identically zero; (3) Every non-negative f(x) in B has a unique representation of the form $\alpha_0 + (p-T)\alpha_1 + \ldots + (p-T)^n\alpha_n$ where $\alpha_i \in H_p$ and α_n is not identically zero, are equivalent. It is shown that metric transitivity implies the existence and uniqueness of the expansions in (2) and (3).

2390

RIAS, Inc., Baltimore, Md.

APPROXIMATE SIMILARITY AND ALMOST PERIODIC MATRICES, by J. C. Lillo. [1960] [8]p. (AF 49(638)-382) Unclassified

Published in Proc. Amer. Math. Soc., v. 12: 400-407, June 1961.

It is shown that if $B(t) \in G^n$ then the system $\dot{x} = B(t)x$, $B(t) \in F^n$ possesses at least one almost periodic Perron transformation. It is also demonstrated, by means of an example that the set of $B(t) \in F^n$, for which there exists at least one almost periodic Perron transformation, is not open in F^n.

2391

RIAS, Inc., Baltimore, Md.

THE ENVIRONMENTAL INFLUENCE ON THE BEHAVIOR OF LONG CHAIN MOLECULES, by R. H. Aranow and L. Witten. [1960] [6]p. incl. diagrs. table, refs. (AFOSR-TN-60-412) (AF 49(638)735) Unclassified

Also published in Jour. Phys. Chem., v. 64: 1643-1648, Nov. 1960.

Transition of a molecule upon a change of environment from the state of internal torsional oscillation to the state of hindered internal rotation can account quantitatively for the entropy of fusion per CH_2 group of long chain hydrocarbons, Traube's rule of surface tension, the distribution ratios of long chain hydrocarbons between water and organic solvents immiscible with water, the solubility in water of liquid long chain hydrocarbons, and the effect of chain length and alcohol on critical micelle concentration. The solutions of crystalline long chain molecules in water are predicted to be a special class of non-ideal solution. (Contractor's abstract)

2392

RIAS, Inc., Baltimore, Md.

PHOTOSYNTHESIS, by G. Hoch and B. Kok. [1960] [40]p. incl. diagrs. refs. (AFOSR-1476) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)947 and National Institutes of Health) AD 263959 Unclassified

Also published in Ann. Rev. Plant Physiol., v. 12: 155-194, 1961.

A selective review of photosynthesis is presented. Topics covered include chloroplast structure, quantum yield R factor, photosynthetic pigments, and chloroplast reactions.

2393

RIAS, Inc., Baltimore, Md.

PHOTOCAPACITANCE EFFECTS IN ADDITIVELY COLORED ALKALI HALIDE CRYSTALS, by D. Kahn and A. J. Glass. [1960] [10]p. incl. diagrs. tables, refs. (AFOSR-3651) [AF 49(638)1017] Unclassified

Published in Jour. Phys. and Chem. Solids, v. 17: 210-219, Jan. 1961.

Also published in Proc. Internat'l. Conf. on Semiconductor, Physics, Prague (Czechoslovakia)(Aug. 29-Sept. 2, 1960), Prague, Publishing House of the Czechoslovak Academy of Sciences, 1961, p. 691-693.

Additively colored alkali halide crystals were placed between current blocking electrodes and an increase in the capacitance and conductance of the crystal was found on illumination. A measurement of these quantities at frequencies between 2 - 1000 c/sec was shown that the observed behavior followed quite closely a linearized theory developed by J. Ross MacDonald. The region of application of the theory was examined experimentally, and results show that the theory could be used for larger applied voltage than assumed in the theory. An analysis of the experimental data indicates that the field induced electrode breakdown for the larger voltages (5 v r. m.s. was of such a nature that the equivalent circuit describing the crystal continued to be valid. This was also observed by others. Using the results of the theory the mobility of KI and KBr crystals at room temperature was measured. These determinations agree substantially with measurements by others using Hall effect method. Measurements at low frequencies revealed phenomena due to

the finite recombination rate of the conduction electrons and ionized F-centers. From the analysis of this behavior, the capture cross section of an ionized F-center in KBr was found to be $3.1 \times 10^{-15}/\nu$ sq cm, where ν is the ratio of the effective electron mass (polaron) to the free electron mass. The recombination rate constant in KBr was also measured. (Contractor's abstract)

2394

Rice U. [Dept. of Mathematics] Houston, Tex.

A FLUX INTEGRAL THEOREM FOR FUNCTIONS WHICH HAVE HARMONIC SUPPORT, by G. Johnson. [1960] [23]p. incl. refs. (AFOSR-TN-60-444) (AF 49-(638)632) AD 237386; PB 148975 Unclassified

Also published in Trans. Amer. Math. Soc., v. 98: 163-185, Jan. 1961.

Logarithmic potential functions defined in plane domains and the problem of the computation of mass distributions by means of the Gauss flux integral formula are discussed. A direct evaluation of a flux integral on an arbitrary rectifiable Jordan curve boundary is developed which does not require the use of approximating regions. A real valued function, u, is said to have harmonic support in a domain, D, if and only if u is subuniformly bounded in D and has at each point of D a support function which is harmonic and single valued in D.

2395

Rice U. [Dept. of Mathematics] Houston, Tex.

ON THE LEBESGUE CONVERGENCE THEOREM, by A. Brown. Sept. 16, 1960, 12p. (AFOSR-TN-60-720) (AF 49(638)632) AD 244284 Unclassified

Also published in Math. Nachr., v. 23: 141-148, 1961.

Versions of the Lebesgue convergence theorem for not necessarily summable functions are considered and the precise role of the condition of equicontinuity from above at 0 in the proof of the theorem is ascertained. Several versions of Lebesgue's convergence theorem are developed from the following statement of the totally finite case: Suppose $\mu(X) < \infty$ and let $\{f_n\}$ be a sequence of functions satisfying the conditions that f is measurable and $\int_X f d\mu$ is defined, such that the sequence $\{\nu_n\}$ of indefinite integrals has the property of being uniformly absolutely continuous. Suppose that $f_n \to f$ (either a.e. or in measure) where f is finite a.e. Then f satisfies the conditions of f measurable and $\int_X f d\mu$ defined, and is concentrated on sets of finite measure if given $\epsilon > 0$ there exists a set F with μ $\mu(F) < \infty$ and $\int_{X-F} |f| d\mu < \epsilon$.

2396

[Rice U. Dept. of Mechanical Engineering, Houston, Tex.]

STACKING FAULTS IN PLATINUM, by J. Taranto and F. R. Brotzen. [1960] [17]p. incl. diagrs. table, refs. [Technical rept. no. 3] (AFOSR-TN-60-882) (AF 49-(638)78) AD 243291 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 221: 645-646, June 1961.

The shift of x-ray diffraction lines was observed at various stages of recovery in filed powder specimens of platinum. As the line shift is a criterion of the change in stacking-fault probability, the disappearance of stacking faults during annealing could be followed in an approximate manner. The kinetics of the annihilation of stacking faults in platinum during annealing can be explained in terms of the mechanism proposed by Kuhlmann, Masing and Raffelsieper (Zeitschr. Metallkunde, v. 40: 241-246, 1949). The activation energy of the annihilation process was estimated to be 28.5 ± 5 kcal/mol, which is substantially less than the activation energy of self diffusion. It is therefore questionable that dislocation climb is responsible for the annealing of stacking faults. The observed probability of stacking faults could be accounted for by the density of extended dislocations in the material. (Contractor's abstract, modified)

2397

[Rochester U. Dept. of Chemistry, N. Y.]

ENERGY TRANSFERAL IN POLYATOMIC MOLECULES AND PHOTOCHEMISTRY IN THE LIQUID AND SOLID PHASES. Final rept. [1960] [12]p. incl. refs. (AFOSR-TR-60-38) (AF 18(600)1528) AD 237786; PB 148090 Unclassified

Attempts were made to use photochemistry as an aid to understanding thermal reactions and to study the photochemical reactions themselves. The major topics studied included: (1) reactions of radicals or atoms, particularly those involving O; (2) the fates of excited molecules, including light absorption, dissociation, fluorescence, and phosphorescence; (3) molecular rearrangements with emphasis on H bridging; and (4) a comparison of light and radiation and their effects on chemical systems. Results indicated that light and radiation produce free radicals in some instances and rearrangements to complete molecules in others. The reactions proceed mainly through 2 states, one of which is short lived. The rearrangements to complete molecules appear to come mainly from the short lived state and reactions which arise from long lived states. Powerful radiations from radioactive substances produce effects which in many cases resemble those formed by the visible or ultraviolet light.

2398

Rochester U. Dept. of Chemistry, N. Y.

THE FLUORESCENCE OF ACETALDEHYDE VAPOR, by E. Murad. [1960] [4]p. incl. diagrs. refs. (AF 18-(600)1528) Unclassified

Published in Jour. Phys. Chem., v. 64: 942-945, July 1960.

The fluorescence spectrum of acetaldehyde extends from 3515 to about 4700A. It consists of a broad diffuse emission with bands superimposed on it, and has a maximum at about 4000A. A microphotometer tracing showed peaks at 3565, 3640, and 3783A. The fluorescence at 3340 was studied at two temperatures, 26 and 52°C. The sensitized phosphorescence of biacetyl when acetaldehyde is irradiated with 3340A indicates that a triplet state of acetaldehyde is formed, but it does not emit. Data collected at 3130A reveal that the behavior of acetaldehyde at this wave length is similar to that of biacetyl at 3660A and acetone at shorter wave lengths. A triplet state must exist, although it seems not to emit radiation. Evidence for this statement is: (1) the effect of oxygen is small, and (2) the phosphorescence of biacetyl (which is from a triplet state) is sensitized by acetaldehyde.

2399

Rochester U. Dept. of Chemistry, N. Y.

THE PHOTOLYSIS AND FLUORESCENCE OF DIETHYL KETONE AND DIETHYL KETONE-BIACETYL MIXTURES AT 3130A AND 2537A, by D. S. Weir. Nov. 14, 1960, 20p. incl. diagrs. tables, refs. (AFOSR-TN-60-1381) (AF 49(638)679) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 2629-2633, June 20, 1961.

The photolysis of diethyl ketone and the photolysis and phosphorescence of diethyl ketone-biacetyl mixtures are studied at 3130A and 2537A. Addition of biacetyl at 3130A decreases the photodecomposition of diethyl ketone and increases the phosphorescence of biacetyl. An energy transfer from excited singlet diethyl ketone to biacetyl is proposed and it is seen that the propionyl radical formed from the singlet state at 3130A is sufficiently hot to dissociate into an ethyl radical and carbon monoxide. A detailed mechanism is presented for the primary process in diethyl ketone and for the energy transfer between diethyl ketone and biacetyl. (Contractor's abstract)

2400

Rochester U. [Dept. of Physics and Astronomy] N. Y.

H-LINE PROFILES AT HIGH GALACTIC LATITUDES, by W. C. Erickson and H. L. Helfer. [1960] [20]p. incl. diagrs. tables. (AFOSR-TN-60-319) (AF 49(638)52) AD 254001 Unclassified

Also published in Astronom. Jour., v. 65: 1-20, Feb. 1960.

Data is presented on the H-line profiles at high galactic latitudes. H-line profiles were observed at 10°-longitude intervals along the ±20°, ±30°, and ±40° parallels of galactic latitude; at 20°-intervals along the ±50° and ±30° parallels; at 40°-intervals along the ±70° and ±80° parallels, and at the poles. In addition, the l^{I} = 150°-330° meridian was also observed at 10°-intervals. Approx 24 observations were taken at points near the galactic plane in 2 series, the first during the summer of 1957 and the second during Jan. 1958. The beam width of the antenna is about 2°, the video frequency of the bandwidth of the receiver is 12 kc/sec, and the profiles consist of averages from 2-18 scans with integration times from 4.8 to 7.5 min. These are profiles of moderate accuracy. A map of the distribution of galactic hydrogen is presented. (Contractor's abstract, modified)

2401

Rochester U. Dept. of Physics and Astronomy, N. Y.

ABUNDANCES IN G DWARF STARS. III. STARS IN MOVING CLUSTERS, by H. L. Helfer, G. Wallerstein, and J. L. Green. [1960] [12]p. incl. diagrs. tables, refs. (AFOSR-TN-60-763) (In cooperation with California Inst. of Tech., Pasadena AF 49(638)21) (AF 49(638)52) AD 254067 Unclassified

Also published in Astrophys. Jour., v. 132: 553-564, Nov. 1960.

Abundance determinations were made for 3 G dwarf stars (1 young, 2 old) that are members of some of Eggen's moving clusters. The metal abundance is roughly solar, but all 3 stars show a slight overabundance of barium and an underabundance of manganese. One star, HD 30455, appears to have a slight underabundance of those elements produced by the e-process, compared to those produced by the s-process. (See also items under California Inst. of Tech., Palomar Observatory, Pasadena). (Contractor's abstract)

2402

Rochester U. Dept. of Physics and Astronomy, N. Y.

THE CRAB AND CYGNUS A AS GAMMA RAY SOURCES, by M. P. Savedoff. [1959] 7p. incl. tables. (AFOSR-J133) (AF 49(638)52) AD 400194 Unclassified

Also published in Nuovo Cimento, Series X, v. 13: 12-18, July 1959.

The Crab is estimated to give a maximum nuclear γ-ray

flux of 10^{-2} cm^{-2} s^{-1} from the decay of Cf^{251} formed with Cf^{253} during the supernova outburst. Although extrapolation of the radio and visual fluxes suggests the possibility of a flux as high as 10 γ cm^{-2} s^{-1} between 1 and 2 mev, model calculations suggest that $7 \cdot 10^{-5}$ γ cm^{-2} s^{-1} above that 10 mev is more probable. Bremsstrahlung and Compton scattering yield considerably lower fluxes. Cygnus A, regarded as the result of a collision of matter and antimatter, should yield lower fluxes than the γ cm^{-2} s^{-1} previously estimated. The radio flux suggests a π° decay γ-flux of $4 \cdot 10^{-5}$ γ cm^{-2} s^{-1}. For E > 10 mev, any γ-ray flux exceeding $5 \cdot 10^{-5}$ γ cm^{-2} s^{-1} should be detectable from a ballon flown emulsion stack.

2403

Rochester U. Dept. of Physics and Astronomy, N. Y.

THE LIFETIME OF THE Σ^+ HYPERON, by M. F. Kaplon, A. C. Melissinos, and T. Yamanouchi. June 1, 1959 [49]p. incl. diagrs. tables, refs. (AFOSR-TN-60-332) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)303] and Atomic Energy Commission under AT(30-1)875) AD 225195; AD 446527 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 30-May 2, 1959.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 4: 289, Apr. 30, 1959.

Also published in Ann. Phys., v. 9: 139-168. Jan. 1960.

The apparent discrepancy in the lifetime of the Σ-hyperons in emulsions was investigated by using the $\Sigma^+ \rightarrow p + \pi^{\circ}$ decay mode. The method of maximum likelihood was used and a detailed description of its applications and limitations is given. Results of Monte Carlo calculations performed to test the consistency of the method are reported and are in complete agreement with the theoretical predictions. By combining data from this laboratory, a sample of 131 events decaying both in flight and at rest is formed. Estimates of the lifetime obtained by using decays in flight (D.I.F.) only and both D. I. F. and decays at rest yield different results; this difference is statistically significant. However, the hypothesis of a double lifetime is not substantiated by the data and is rejected. Comparison with bubble chamber data is also made and it is concluded that the best value for the Σ^+-hyperon lifetime is $\tau = (.70 \pm .15) \times 10^{-10}$ sec. Detailed data, obtained in this laboratory, on 130 charged Σ-hyperons is presented in tabular form. (Contractor's abstract)

2404

Rochester U. Dept. of Physics and Astronomy, N. Y.

A SURVEY OF RELATIVISTIC TRANSFORMATIONS, by M. F. Kaplon and T. Yamanouchi. Aug. 1, 1959 [29]p. incl. diagrs. (AFOSR-TN-60-333) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)303] and Atomic Energy Commission under AT(30-1)875) AD 446409 Unclassified

Also published in Nuovo Cimento, Series X, v. 15: 519-536, Feb. 16, 1960

The usefulness of invariance properties in calculating various kinematical quantities relevant to particle physics is outlined and examples given. General formulae relating to the transformation of distributions from one Lorentz system to another are given and their uses demonstrated. Particular application is made to the γ-ray distribution arising from π°-decay. (Contractor's abstract)

2405

Rochester U. Dept. of Physics and Astronomy, N. Y.

PRIMARY COSMIC-RAY α-PARTICLES, I, by A. Engler, M. F. Kaplon and others. [1960] [29]p. incl. diagrs. table, refs. (Technical rept. no. 44) (AFOSR-TN-60-1389) (In cooperation with Washington U., St. Louis, Mo. AF 18(603)108) (AF 49(638)303) AD 260596 Unclassified

Also published in Nuovo Cimento, Series X, v. 19: 1090-1099, Mar. 16, 1961.

The primary cosmic-ray alpha-particle energy spectrum has been investigated, using photographic emulsions flown from Minneapolis on July 30th, 1957. The total flux observed was (151 ± 9) particles/cm^2 ster sec. The differential energy spectrum shows a broad maximum between 400 and 600 mev/nucleon, and appears in shape from the spectrum observed at solar minimum. No particles were observed to have kinetic energies below 200 mev/nucleon, but a substantial flux was observed between 200 and 300 mev/nucleon. From the centered dipole approximation to the geomagnetic field, one would expect a cut-off energy at this latitude of 292 mev/nucleon. The results presented here are in disagreement with this figure, but do not allow a choice to be made between cut-off energies predicted from other models. (Contractor's abstract)

2406

Rochester U. [Dept. of Physics and Astronomy] N. Y.

STRANGE PARTICLE INTERACTIONS, by M. F. Kaplon. [1960] [14]p. incl. illus. diagrs. tables, refs. (AFOSR-4116) [AF 49(638)303] Unclassified

Also published in Proc. of Annual Internat'l. Conf. on High Energy Physics at CERN, Geneva (Switzerland) (June 30-July 5, 1958), Geneva, CERN, Scientific Information Service, 1958, p. 171-186.

A discussion of K^+ interactions, K^- interactions, neutral K interactions, and hyperon interactions is presented. Data are presented which are relatively free from detailed model considerations. Generally, it appears that the K mesons are bosons of unknown parity and the hyperons are fermions, most probably with spin 1/2. There is abundant evidence that there exist attractive Λ^0-nucleon forces and some suggestions of similar forces for the Σ^+ hyperons.

2407

Rochester U. [Dept. of Physics and Astronomy] N. Y.

ON GABOR'S EXPANSION THEOREM, by K. Miyamoto. [1960] [3]p. incl. diagrs. refs. (Technical note no. 3) (AFOSR-TN-60-185) (AF 49(638)602) AD 255650 Unclassified

Presented at meeting of the Opt. Soc. Amer., Washington, D. C., Apr. 7, 1960.

Abstract published in Jour. Opt. Soc. Amer., v. 50: 502, Feb. 1960.

Also published in Jour. Opt. Soc. Amer., v. 50: 856-858, Sept. 1960.

As a generalization for optics of the well-known sampling theorem of information theory, D. Gabor proposed an expansion theorem. It relates to the number of independent solutions of the wave equation in a region defined by the object and by the aperture of an optical system. A proof of this theorem presents formidable difficulties. Here, a proof relating to important cases is established, and a more accurate estimate for the number of the independent solutions in the general case is given. (Contractor's abstract, modified)

2408

Rochester U. [Dept. of Physics and Astronomy] N. Y.

CORRELATION THEORY OF STATIONARY ELECTROMAGNETIC FIELDS. PART II. CONSERVATION LAWS, by P. Roman and E. Wolf. Feb. 1960, 21p. (Technical note no. 2) (AFOSR-TN-60-186) (AF 49(638)602) AD 235570 Unclassified

Also published in Nuovo Cimento, Series X, v. 17: 477-490, Aug. 16, 1960.

Two new second order space-time correlation tensors $W_{jk}(x_1, x_2, \tau)$ and $I_{jk}(x_1, x_2, \tau)$ are introduced, which are simple linear combinations of the correlation tensors discussed in Part I (see item no. 1880, Vol. III) of this investigation (x_1, x_2 are position vectors of 2 points and τ a time delay). These new tensors are intimately related to certain generalizations of the (time averaged) energy density and the energy flow vector. Differential equations which W_{jk} and I_{jk} satisfy in free space are derived, and from them 4 new conservation laws are deduced. In the limit $x_1 \to x_2$, $\tau \to 0$ two of these laws reduce to the usual laws (in time averaged form) for the conservation of the energy and the momentum in an electromagnetic field. The other 2 laws reduce only to trivial identities in this limit, so that they have no analogy in the framework of the usual theory. (Contractor's abstract)

2409

Rochester U. [Dept. of Physics and Astronomy] N. Y.

CORRELATION BETWEEN PHOTONS IN PARTIALLY POLARIZED LIGHT BEAMS, by E. Wolf. [1960] [3]p. incl. refs. (Technical note no. 4) (AFOSR-TN-60-275) (AF 49(638)602) AD 255649 Unclassified

Presented at meeting of the Opt. Soc. Amer., Washington, D. C., Apr. 7, 1960.

Also published in Jour. Opt. Soc. Amer., v. 50: 502, Feb. 1960.

Also published in Proc. Phys. Soc., v. 76: 424-426, 1960.

Results of studies made by Hanbury Brown and Twiss show that the fluctuations in the current outputs from 2 photoelectric detectors illuminated by a coherent or partially coherent light beam are in general correlated. An extension of the results to partially polarized light is made and it is shown that the Hanbury Brown-Twiss effect can also be used to determine the degree of polarization of a light beam. The correlation between the fluctuations in the output from 2 photoelectric detectors, illuminated by 2 portions of a partially polarized beam is given by $\overline{\Delta n_1 \, \Delta n_2} = 1/2(1 + P^2)(\tau_0/T)\, \bar{n}_1 \, \bar{n}_2$, n being the polarization component and P the degree of polarization. Applications are mentioned where the technique would possibly have theoretical interest.

2410

Rochester U. [Dept. of Physics and Astronomy] N. Y.

CONTRIBUTION TO THE THEORY OF THE BOUNDARY DIFFRACTION WAVE (Abstract), by E. Wolf and K. Miyamoto. [1960] [1]p. [AF 49(638)602] Unclassified

Presented at meeting of the Opt. Soc. Amer., Boston, Mass., Oct. 12-14, 1960.

Published in Jour. Opt. Soc. Amer., v. 50: 1131, Nov. 1960.

An early attempt of Thomas Young to explain diffraction at an aperture as a combined effect of interference of a direct wave and a wave "reflected" from the edge of the aperture was put on a sound mathematical basis by G. A. Maggi, A. Rubinowicz, and F. Kottler. These authors showed that, when the incident wave is plane or spherical, Kirchhoff's diffraction integral can be transformed exactly into the sum of two terms, one of which represents the unperturbed field propagated according to the laws of geometrical optics, while the other depends only on the wave disturbance at the aperture edge. It is shown here that an exact mathematical generalization of this theorem exists, irrespective of the nature of the incident field. This result suggests the possibility of a new approach to the study of diffraction effects of aberrations: the diffraction image may, in general, be regarded as arising from the interference of a boundary diffraction wave with waves (in most cases finite in number) propagated from certain special points situated within the aperture.

2411

Rochester U. [Dept. of Physics and Astronomy] N. Y.

DETECTION OF INTERFERENCE EFFECTS WITH INCOHERENT LIGHT BEAMS BY PHOTON COUNTING (Abstract), by L. Mandel. [1960] [1]p. [AF 49(638)602] Unclassified

Presented at meeting of the Opt. Soc. Amer., Boston, Mass., Oct. 12-14, 1960.

Published in Jour. Opt. Soc. Amer., v. 50: 1131, Nov. 1960.

The transient interference phenomena associated with the superposition of two incoherent light beams are described briefly. Both the position and the modulation amplitude of the fringes are predictable in statistical terms only. Although the effects should be most readily observable with image preserving detectors, they should, in principle, also be detectable by photon counting over time intervals of the order of a few coherence times. It is shown that the variance of the number of counts is depressed in the presence of interference effects to an extent depending on the fringe spacing.

2412

Rochester U. [Dept. of Physics and Astronomy] N. Y.

PROCEEDINGS OF THE 1960 ANNUAL INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS AT ROCHESTER, N. Y., Aug. 25-Sept. 1, 1960, ed. by E. C. G. Sudarshan, J. H. Tinlot, and A. C. Melissinos. New York, Interscience Publishers, 1960, 890p. incl. illus. diagrs. tables, refs. (AFOSR-1646) (Sponsored jointly by Air Force Office of Scientific Research under [AF AFOSR-60-11], Atomic Energy Commission, International Union of Pure and Applied Physics, National Academy of Sciences, National Science Foundation, and Office of Naval Research) Unclassified

This conference was the tenth in a series of which the first seven were held at Rochester U., the eighth at CERN, and the ninth in Kiev. The purpose of this annual conference is to assemble a representative group of workers from high energy laboratories throughout the world for an informal and comprehensive discussion of the experimental and theoretical developments during the previous year. This year's conference was attended by approximately 350 physicists, representing laboratories from 30 countries. Invited and contributed papers covered four major fields of activity: (1) experimental aspects of strong interactions of pions and nucleons; (2) theoretical aspects of strong interactions of pions and nucleons; (3) strong interactions of strange particles; and (4) weak interactions. Topics discussed of general interest included the structure of elementary particles, new results at superhigh energies, and theories of elementary particles.

2413

Rochester U. Inst. of Optics, N. Y.

ELECTRON-HOLE PAIR PRODUCTION, by D. L. Dexter. Jan. 1960 [22]p. incl. diagrs. refs. (AFOSR-TN-60-99) (AF 49(638)432) AD 233017; PB 145733 Unclassified

Also published in Proc. Internat'l. Conf. on Semiconductor Physics, Prague (Czechoslovakia) (Aug. 29-Sept. 2, 1960), Prague, Publishing House of the Czechoslovak Academy of Sciences, 1961, p. 122-126.

For a rather general band structure, the transition probability is computed for across-the-gap impact ionization by a fast particle in a semiconductor, taking into account various possibilities involving tensor masses, non-equivalent energy surfaces, umklapp-processes, etc. Some discussion is given of possible uses of the results (Contractor's abstract)

2414

Rochester U. Inst. of Optics, N. Y.

IMPURITY STATES IN SOLID NEON, by A. Gold. June 1960, 63p. incl. tables, refs. (Technical rept. no. 6) (AFOSR-TN-60-705) (AF 49(638)432) AD 241630; PB 150201 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 18: 218-237, Feb. 1961.

A formalism for the treatment of optical absorption by an isolated substitutional impurity center is given. The tight-binding approximation is used and the method of constructing 1-electron trial functions for the system is outlined. The first-order absorption energies,

oscillator strengths, and integrated absorption coefficients are computed in an approximation which includes spin-orbit interaction and the overlapping of heterocentric atomic wave functions through terms of order S^2. The first-order energies are corrected for van der Waals interactions using a variational formalism. A phenomenological method for computing the emission energies of the system is given. The specific example of an argon impurity atom in solid neon is treated numerically. The computation predicts absorption lines at 11.7 and 11.6 ev due, respectively, to the $^1P_1$ and $^3P_1$ states of the argon impurity, with an uncertainty of 1.3 ev. The oscillator strengths for these transitions are calculated to be 0.164 and 0.017, respectively, giving rise to integrated absorption coefficients of $0.84 \times 10^6 N_0$ and $0.09 \times 10^6 N_0$ ev cm^{-1} for the 2 states, where N_0 is the small fractional concentration of impurities in the host lattice. (Contractor's abstract)

2415

Rochester U. Inst. of Optics, N. Y.

THE INTERNATIONAL INSTITUTE ON QUANTUM CHEMISTRY, by A. Gold. Sept. 1960 [14]p. incl. refs. (Technical rept. no. 7) (AFOSR-TN-60-1392) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)432, King Gustaf VI, Adolf's 70-Years Fund for Swedish Culture, Knut and Alice Wallenberg's Foundation, National Science Foundation and Swedish National Science Research Council) AD 243801 Unclassified

Also published in Phys. Today, v. 14: 40-43, Jan. 1961. (Title varies)

A description is given of the Third Summer Institute in Quantum Chemistry, held in Uppsala, Sweden from July 17 through Aug. 21, 1960. The meeting was arranged by the Quantum Chemistry Group of Uppsala U. and the Quantum Theory Group of Florida U. and was directed by Professor Per-Olov Löwdin of Uppsala and Florida. The participants, activities and purpose are listed. Only the work which appeared to be of particular interest and novelty is treated here.

2416

Rochester U. Inst. of Optics, N. Y.

A REFLECTOMETER FOR THE VACUUM ULTRAVIOLET, by A. Smith. Feb. 2, 1960 [11]p. incl. illus. diagrs. (Technical note no. B-4) (AFOSR-TN-60-284) (AF 49(638)433) AD 234920; PB 149651 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 50: 862-864, Sept. 1960.

A newly designed device for the measurement of absolute reflectance in the vacuum ultraviolet region is discussed. Notable features of this reflectometer are compactness and simplicity. The source and monochromator with which the reflectometer is used are also discussed. The system produces data in the wavelength range 800A to 2500A at any angle of incidence between 15° and 80°. A sample reflectance curve for a crystal of KCl is shown. (Contractor's abstract)

2417

Rochester U. School of Medicine and Dentistry, N. Y.

THE MECHANISM OF CARDIOVASCULAR ACTION OF NITROGLYCERINE, by C. R. Honig, S. M. Tenney, and P. V. Gabel. [1960] [14]p. incl. diagrs. table, refs. (AFOSR-337) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)81 and National Institutes of Health) AD 251466 Unclassified

Also published in Amer. Jour. Med., v. 29: 910-923, Dec. 1960.

The effects of nitroglycerine on phasic pressure, flow and myocardial oxygen tension were measured in anesthetized spontaneously breathing dogs. As aortic pressure fell, cardiac output increased from 10 to 55% for 1/2 to 3-1/2 , then fell 10 to 25% below control levels as the diastolic pressure recovered. Prolonged increases in flow depended upon adequate thoracic blood volume, sympathetic tonus and release of pressor amines. Under conditions most closely resembling those in man, measurements in dogs indicated a rise in left ventricular external work of as much as 25%. Despite this additional load, myocardial oxygen tension increased. In contrast, when venous return was compromised both external work and myocardial oxygen tension fell. Indirect evidence is presented which suggests that qualitatively similar changes take place in patients with coronary artery disease. Results indicate that nitroglycerine relieves ischemia by enhancing oxygen delivery rather than by altering load. (Contractor's abstract)

2418

Rome U. [Dept. of Pharmacology] (Italy).

BRAIN UNIT ACTIVITY IN RELATION TO BEHAVIOR, by G. Ricci. Final technical rept. Dec. 31, 1959, 47p. incl. diagrs. refs. (AFOSR-TR-60-55) (AF 61(052)38) AD 244874 Unclassified

In monkeys conditioned to light (CS) followed by shocks to the hand (UCS) that can be avoided by the animal, the presentation of a sound preceding and accompanying a light, but not followed by shock (DS), causes an initial inhibition of the conditioned responses (Pavlov's external inhibition). In successive trials, however, the conditioned responses reappear. The EEG arousal caused by DS shows a tendency to progressively disappear (habituation). In the animal not conditioned the habituation comes more rapidly. At the level of the

occipital cortex, the photic driving and the potentials evoked by the conditioning stimulus diminish in amplitude during CR, while during DS they remain constant and regular for the whole period of the stimulation. The study with microelectrodes of the electrical activity of 64 units of the occipital cortex, showed that various patterns of activity are present in this region during CS and CR. The results seem to justify the hypothesis that diminution of the evoked potentials is due to a desynchronization of the cortical activity rather than to a diminution of afferent impulses from the periphery. Single shock stimulation of specific thalamic nuclei was performed, and modification induced by conditioning on the primary responses evoked in the sensory and motor cortex was examined.

2419

Rome U. School of Aeronautical Engineering (Italy).

SIMILAR SOLUTIONS IN RE-ENTRY LIFTING TRAJECTORIES, by L. Broglio. Dec. 1959 [32]p. incl. diagrs. (Technical note no. 3; SIARgraph no. 54) (AFOSR-TN-60-678) (AF 61(052)198) AD 239814; PB 149586 Unclassified

An analysis is presented of re-entry trajectories. Two equations of motion, valid at any altitude, are written by considering all the external forces. The equations are made non-dimensional by taking the deceleration peak as the reference point, thus eliminating the ballistic parameter. The remaining parameters are the value of the deceleration peak, the flight path angle at the deceleration peak, and the lift/drag ratio. A similarity law is obtained which relates bodies of different inertial and aerodynamic characteristics. The heat rate and total heat are calculated with accuracy. Results are presented for an escape re-entry speed, for a given deceleration peak, and for several constant lift/drag ratios. Similar results are shown for an orbital re-entry speed. (Contractor's abstract)

2420

Royal Coll. of Science and Tech. Dept. of Mathematics, Glasgow (Scotland).

THE FLOW PAST A CLOSED BODY IN A HIGH SUBSONIC STREAM, by J. B. Helliwell and A. G. Mackie. [1959] [16]p. incl. diagrs. tables. (AFOSR-TN-60-348) (AF 61(514)1170) AD 242392 Unclassified

Also published in Quart. Jour. Mech. and Appl. Math., v. 12: 298-313, Aug. 1959.

A solution of Tricomi's equation is obtained for the flow past a thin, doubly symmetric body placed at zero incidence in a high subsonic stream in which sonic velocity is attained along a segment of the body. This flow is the compressible analogue of the Riabouchinsky model for incompressible fluids. The singularity in the hodograph plane corresponding to the point at infinity in the physical plane is essentially different from that which occurs in other similar problems. The boundary value problem is of mixed type and this is shown to lead to a pair of dual integral equations for which the solution is obtained. Numerical results are given which specify the dimensions of the body corresponding to a range of incident Mach numbers. By symmetry the total drag on the body is zero. (Contractor's abstract)

2421

Royal Coll. of Science and Tech. Dept. of Mathematics, Glasgow (Scotland).

THE HODOGRAPH METHOD APPLIED TO FLOW PAST PROFILES AND IN JETS, by D. C. Pack. Final technical rept. Apr. 1960, 53p. incl. diagrs. tables, refs. (AFOSR-TR-60-61) (AF 61(514)1170) AD 241472; PB 150038 Unclassified

The solution of the Tricomi equation is found for subsonic and sonic flows past thin wedges in an infinite stream or a wind-tunnel with parallel walls, for certain flow models. Drag coefficients were calculated and the effect of the presence of walls was assessed. A problem, analogous to the Riabouchinsky problem for incompressible fluids was formulated and solved for the Tricomi equation. The Chaplygin equation was solved for simple wedge flows. A numerical comparison of the drag for a thin wedge in a jet was made for the exact Chaplygin equation and for the Tricomi and the Tomotika and Tamada approximations. It is proved that for simple flows past wedges involving sonic jets, the physical changes due to the presence of solid boundaries in the flow are completed within a finite distance in those directions in which sonic jet flow prevails. This generalizes a result first given for the critical jet by Guderley. Germain's inversion theorem is used to find the solution of the Roshko problem for the generalized hodograph equation.

2422

Royal Coll. of Science and Tech. Dept. of Mathematics, Glasgow (Scotland).

UNSYMMETRICAL FLOW PATTERNS PAST A FINITE WEDGE PROFILE IN A HIGH SUBSONIC STREAM, by J. B. Helliwell. [1960] [14]p. incl. diagrs. refs. (Technical note no. 1) (AFOSR-916) (AF 61(052)-407) AD 264001 Unclassified

Also published in Proc. Cambridge Philos. Soc., v. 57: 401-414, 1961.

The flow pattern past a thin wedge-like profile set at a small angle of attack in a gas flowing with high subsonic or sonic velocity is discussed within the order of the transonic approximation. In the model considered the flow has a stagnation point at the nose of the wedge and breaks away, with velocity equal to that of sound from the shoulders. The velocity is subsonic throughout the

whole field of flow. The solution of the boundary-value problem for the wedge in a channel is formulated as a pair of dual integral equations. The complete solution is given for the wedge in a free stream and the dimensions of the profile, together with the lift coefficient, are computed as functions of the transonic similarity parameter. (Contractor's abstract)

2423

Royal Inst. of Tech., Stockholm (Sweden).

LIQUID FLOW IN TUBES. IV. THE TRANSITION PROCESS AND TURBULENT FLOW RELATED TO TUBE DIAMETER AND MICROSCOPIC SURFACE PROPERTIES, by E. R. Lindgren. [1960] [16]p. incl. illus. diagrs. refs. (AFOSR-330) (Sponsored jointly by Air Force Office of Scientific Research under AF 61-(052)375, Swedish Natural Science Research Council, and and Swedish State Council of Technical Research)
AD 436362 Unclassified

Also published in Arkiv Fysik, v. 18: 449-464, 1961.

The experiments indicate the influence of tube diameter and microscopic surface roughness on certain transition quantities. Thus, the transition Reynolds number, R (= the lowest Reynolds number at which self-preserving turbulent slugs ever appear), increased from about 1800 to 2200 (ca. 20% increase) when the tube diameter increased from about 4 mm to 24 mm (ca. 600% increase). A change of the microscopic surface roughness by sandblasting of the tubes did not influence the R values nor the relative rear velocity of the turbulent slugs. However, it did increase their relative front velocity and also decreased the critical Reynolds number R_k (= the Reynolds number at which the turbulent slugs begin to split or expand during their downstream travel). Hence, in considering present and previous experimental findings, it seems that the transition process and turbulence maintenance mechanism involve a complicated pattern of factors which at present cannot be separated from one another. (Contractor's abstract)

2424

Royal Inst. of Tech., Stockholm (Sweden).

LIQUID FLOW IN TUBES. V. EFFECTS OF LATERAL TUBE DEFLECTIONS ON SOME TURBULENT TRANSITION QUANTITIES, by E. R. Lindgren. [1960] [9]p. incl. diagrs. (AFOSR-331) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)-375, Swedish Natural Science Research Council, and Swedish State Council of Technical Research)
AD 436280 Unclassified

Also published in Arkiv Fysik, v. 18: 533-541, 1961.

Previous investigations in this series of publications on the transition pattern for tube flow of liquids have shown that both structural flow of liquids have shown that both structural properties of the liquids as well as microscopic mechanical properties of the tube walls may influence several characteristics of the appearance and development of turbulent slugs. The present observations further indicate that rather slight lateral tube deflections may influence the transition pattern, causing the burst and development of turbulent slugs in primarily undisturbed laminar flow at higher Reynolds numbers, while simultaneously a distinct damping effect is noted on the rate of development of already existing turbulent streaks when compared with their rate of extension in straight tube flow. Furthermore, within the region of transition at lower Reynolds numbers, the damping effect may dominate over the self-preserving turbulence mechanism to such an extent that turbulent slugs developed in a straight part of the tube may be damped out completely in a following curved part of it. The findings seem to complete observations on flow through helical tubes reported by C. M. White (Proc. Royal Soc. (London), v. 123A: 645, 1929) and G. I. Taylor (Proc. Royal Soc. (London), v. 124A: 243, 1929). (Contractor's abstract)

2425

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

QUANTITATIVE STUDIES OF HYDROLYTIC EQUILIBRIA, by L. G. Sillén. [1959] [23]p. incl. diagrs. refs. (Technical note no. 5) (AFOSR-TN-60-175) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)162, Swedish Atomic Energy Commission, Swedish Natural Science Research Council, and Swedish Technical Research Council) AD 244426
Unclassified

Also published in Quart. Rev., v 13: 146-168, 1959.

A review is presented of previous work on hydrolytic equilibria of cations and anions carried out in Stockholm during the last 10 yr. Among the topics discussed are cationic systems, dinuclear and polynuclear complexes, series of complexes, structure of the complexes, and anionic hydrolysis. It is concluded that for the systems discussed emf method appear to give the most reliable data about the species present and the equilibrium constants. It is suggested, however, that emf methods be supplemented, wherever possible, by other equilibrium methods, such as solubility and distribution studies, and by spectral "finger-print" methods. The latter may be used to check the results obtained with emf data, and also to extend the measurements in the ranges where the accuracy of emf data is insufficient.

2426

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

THE HYDROLYSIS OF LEAD(II) IN PERCHLORATE MEDIUM, by A. Olin. [1960] [25]p. incl. diagrs. tables,

refs. (Technical note no. 6) (AFOSR-TN-60-176) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)162 and Swedish Technical Research Council) AD 244427 Unclassified

Also published in Acta Chem. Scand., v. 14: 126-150, 1960.

The hydrolysis of lead(II) has been studied at 25°C by inert medium method using 3 M or 0.3 M $(Na)ClO_4$ and the cells -Pb-Hg/S/ref. + and - glass/S/ref. +. S had the general composition B M Pb(II), H M H^+, (I-2B-H) M Na^+, I M ClO_4^-. The experimental data Z (average number of OH^- bound per lead(II) and η (log $[Pb(II)]_{tot}/[Pb^{2+}]$free) as functions of log h are explained by reactions and equilibrium constants. (Contractor's abstract)

2427

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

APPLICATION OF THE SELF-MEDIUM METHOD TO THE HYDROLYSIS OF LEAD(II) PERCHLORATE SOLUTION, by A. Olin. [1960] [9]p. incl. diagr. table, refs. (Technical note no. 7) (AFOSR-TN-60-177) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)162 and Swedish Technical Research Council) AD 255003 Unclassified

Also published in Acta Chem. Scand., v. 14: 814-822, 1960.

The hydrolysis of Pb(II) has been studied at high Pb^{2+} concentrations, B, in order to enhance the relative amounts of species with a $OH^-/Pb(II)$ ratio < 1. The equilibrium solutions measured had the general composition B M Pb(II), H M H^+, (3-2B-H) M Na^+, 3 M ClO^-_4 and the hydrolysis was followed to Z = 0.15 for B = 1.490, 0.990 and 0.500 M. Z is the average number of OH^- groups bound to each Pb(II). If it is assumed that the activity factors stay constant at low Z, the data up to Z = 0.10 may be interpreted by the following reactions and equilibrium constants: (a) $4Pb^{2+} + 4H_2O \rightleftharpoons Pb_4(OH)_4^{4+} + 4H^+$; $\log \beta_{4,4} = -19.25$ (B 50 M), -19.23 (B = 0.99 M), -19.28 (B = 1.49 M), and (b) $2Pb^{2+} + H_2O \rightleftharpoons Pb_2OH^{3+} + H^+$; $\log \beta_{1,2} = 6.45$ (B = 0.50 M), -6.45 (B = 0.99 M), -6.34 (B = 1.49 M). For higher values of Z deviations appear which may be due either to complexes other than Pb_2OH^{3+} and $Pb_4(OH)^{4+}$ or to variations in the activity factors. (Contractor's abstract)

2428

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

THE FIRST STEP IN THE ACIDIFICATION OF WO_4^{2-}; EQUILIBRIA IN 3 M $NaClO_4$ AT 25°C, by Y. Sasaki. June 19, 1960 [26]p. incl. diagrs. tables, refs. (Technical note no. 8) (AFOSR-TN-60-178) (AF 61(052)162) AD 241949; PB 150335 Unclassified

Also published in Acta Chem. Scand., v. 15: 175-189, 1961.

The reaction between H^+ and the wolframate ion, WO_4^{2-}, has been studied at 25°C in 3 M $NaClO_4$ medium using a glass electrode. The main reaction was found to be: $7\,H^+ + 6\,WO_4^{2-} \rightleftharpoons 3\,H_2O + HW_6O_{21}^{5-}$ with the equilibrium constant log K = 60.68 ± 0.03. Upon further acidification, a range with slow reactions was encountered. The product $HW_6O_{21}^{5-}$, which is probably identical with the parawolframate A of Souchay and others, undergoes a slow reaction which does not seem, however, to affect the present data. (Contractor's abstract)

2429

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

ON THE CRYSTAL STRUCTURE OF A BASIC ALUMINIUM SULFATE AND THE CORRESPONDING SELENATE, by G. Johansson, G. Lundgren and others. [1960] [3]p. incl. table. (Technical note no. 9) (AFOSR-TN-60-1259) (AF 61(052)162) AD 252398 Unclassified

Also published in Acta Chem. Scand., v. 14: 769-771, 1960.

Preliminary results are given for the compounds $Na_2O{\cdot}13Al_2O_3{\cdot}8SO_3{\cdot}xH_2O$ and $Na_2O{\cdot}13Al_2O_3{\cdot}8SeO_3{\cdot}xH_2O$ with x apparently varying between 76 and 68. The investigation shows that alkali metal ions are an essential constituent of the salts. The aluminum chloride solution is heated to 80°C and hydrolyzed by adding about 2.5 equivalents of sodium hydroxide. The solution is then kept at 80°C for about 30 min, after which the basic salts be precipitated by the addition of sodium sulfate or selenate solutions. Analyses show the anion and cation form of the compound. The water content and crystallographic structure are investigated also.

2430

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

STUDIES IN THE HYDROLYSIS OF METAL IONS. 33.

A MINIATURE SOLUBILITY COLUMN AND ITS APPLICATION TO A STUDY OF THE SOLUBILITY OF RED MERCURY(II) OXIDE IN ACID 3 M $NaClO_4$ SOLUTIONS, by D. Dyrssen and V. Tyrrell. [1960] [10]p. incl. diagrs. tables, refs. (AFOSR-196) [AF 61(052)162] Unclassified

Also published in Acta Chem. Scand., v. 15: 393-402, 1961.

A scaled-down version of a conventional solubility column which uses only about 2 g of solid material is described. It is well-adapted for handling radioactive materials, and has been used for radiochemical measurements of the solubility of red mercury(II) oxide in 3 M $NaClO_4$ solutions in the pH range 1-5. The results compare favorably with those of Garett et al, who obtained equilibrium by shaking for 3 wk followed by settling for 3 to 5 days. Further improvements in the present method are proposed. The presence of Hg^{2+}, $HgOH^+$, and $Hg(OH)_2$ as the only mercury-containing species is confirmed, and values for the equilibrium constants calculated.

2431

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

STUDIES ON THE HYDROLYSIS OF METAL IONS. 34. THE HYDROLYSIS OF THE INDIUM(III) ION, In^{3+}, IN 3 M(Na^+) Cl^- MEDIUM, by G. Biedermann, N. C. Li, and J. Yu. [1960] [10]p. incl. diagrs. table, refs. (AFOSR-197) (In cooperation with Duquesne U., Pittsburgh, Pa.) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)162, Atomic Energy Commission, and Swedish Natural Science Research Council) AD 611299 Unclassified

Also published in Acta Chem. Scand., v. 15: 555-564, 1961.

The hydrolysis equilibria of In(III) have been studied at 25° in the ionic medium 3 M(Na^+)Cl^- by measuring the hydrogen ion concentration with a glass electrode. The [In(III)] ranged from 1×10^{-3} to 4×10^{-2}M, and the hydrogen ion concentration was varied from values high enough for the hydrolysis to be negligible to those low enough for a precipitate to be formed. The data could be explained by assuming the equilibria:

$In^{3+} + H_2O \rightleftharpoons InOH^{2+} + H^+$, $\log k_{a1} = -6.9_5 \pm 0.1$;

$2In^{3+} + 2H_2O \rightleftharpoons In_2(OH)_2^{4+} + 2H^+$, $\log \beta_{22} = -10.I_5 \pm 0.1$.

Comparison with the equilibrium constants for the formation of the species $InOH^{2+}$ and $In_2(OH)_2^{4+}$ in 3 M(Na^+)ClO_4^-, given in a previous work (Arkiv Kemi, v. 9: 277, 1956), indicates that in 3 M(Na^+)Cl^- medium the species denoted by the collective formulas $InOH^{2+}$ and $In_2(OH)_2^{4+}$ are in reality mainly mixed Cl^- - OH^- - complexes (just as In^{3+} denotes mainly Cl^- complexes). (Contractor's abstract)

2432

Royal Inst. of Tech. [Dept. of Inorganic Chemistry] Stockholm (Sweden).

CRYSTAL STRUCTURE STUDIES ON SOME BASIC SALTS OF Ce(IV), Th(IV), U(IV), Ti(IV), AND Zr(IV), by G. Lundgren. [1959] [21]p. (AFOSR-3377) [AF 61(052)-162] Unclassified

Also published in Svensk Kemisk Tidskrift, v. 71: 200-220, 1959.

Previously published crystal-structure details of $Th(OH)_2SO_4$, $U(OH)_2SO_4$, $U_6O_4(OH)_4(SO_4)_6$, $Ce_6O_4(OH)_4(SO_4)_6$, $CeOSO_4.H_2O$, $TiOSO_4.H_2O$), and $Zr_4(OH)_6(CrO_4)_5(H_2O)_2$ are reviewed. The relations between the oxide or hydroxide complexes in the crystals and the structures of the corresponding dioxides are discussed. Most of the M-O or M-OH complexes found can be considered as parts of an oxide structure. An exception is the mixed hydroxide-chromate complex $(Zr_4(OH)_6CrO_4^{8+})_n$ in the crystals of $Zr_4(OH)_6(CrO_4)_5 \cdot H_2O)_2$. The complexes in the crystals are compared with those found from investigations of the complexes in partially hydrolized M(IV) solutions.

2433

Royal Inst. of Tech. Div. of Gasdynamics, Stockholm (Sweden).

THE EFFECT OF THE MOLECULAR MODEL ON SOLUTIONS TO LINEARIZED COUETTE FLOW FOR LARGE KNUDSEN NUMBER, by D. R. Willis. Dec. 1960, 29p. incl. refs. (Technical note no. 1) (AFOSR-417) (AF 61(052)348) AD 254995 Unclassified

Also published in Rarefied Gas Dynamics; Proc. Second Internat'l. Symposium, California U., Berkeley [Aug. 3-6, 1960], New York, Academic Press, 1961, p. 429-449.

Sufficient conditions are derived for the convergence of an iterative method of solving the linearized Boltzmann equation for problems with parallel plate geometry, and molecules with a finite collision cross-section. The conditions are proved to be satisfied for Couette flow with hard sphere molecules. In this case the velocity slope is proportional to Kn^{-1} (ln Kn), when Kn, the Knudsen number, is large. This proves that the expansion techniques for solving the linearized Boltzmann equation are

not correct in this case, and demonstrates the importance of the iterative techniques based on an integral equation formulation of the problem. (Contractor's abstract)

2434

Royal Inst. of Tech. Div. of Gasdynamics, Stockholm (Sweden).

CENTER-POINT MASS FLOW THROUGH A CIRCULAR ORIFICE USING THE INTEGRAL ITERATION METHOD, by D. R. Willis. Dec. 1960, 44p. incl. diagrs. tables, refs. (Technical note no. 3) (AFOSR-535) (AF 61(052)-348) AD 254997 Unclassified

The mass flow is calculated from the first iterate and for large Knudsen number (Kn) = 1 + 0.29/Kn. Numerical calculations showed that this is a reasonable approximation for Kn ≥ 6. The treatment is axisymmetric, and the results show that previous quasi-1-dimensional analyses could give non-realistic results. (Contractor's abstract)

2435

Royal Inst. of Tech. Div. of Gasdynamics, Stockholm (Sweden).

INVESTIGATION OF THE DEVELOPMENT OF A SHOCK WAVE FOR TIMES SMALLER THAN THE AVERAGE COLLISION TIME, by D. R. Willis. Dec. 1960, 42p. incl. diagrs. tables. (Technical note no. 4) (AFOSR-536) (AF 61(052)348) AD 254998 Unclassified

The timewise development of a shock wave, as an infinite flat plate moves perpendicular to its plane into a gas initially at equilibrium, is studied from the kinetic theory standpoint. The problem is analyzed using the integral iteration method. Analytic results are given for the free molecular regime, and preliminary numerical results are given for times less than and equal to the average collision time. Some effects of the numerical techniques are discussed, and suggestions are given for improving those that seemed to be inefficient for times larger than the average collision time. (Contractor's abstract)

2436

Royal Inst. of Tech. Div. of Gasdynamics, Stockholm (Sweden).

ON THE POSSIBILITY OF DETERMINING SURFACE INTERACTIONS BY MEASURING THE NUMBER FLUX OF MOLECULES REFLECTED FROM A MOVING TARGET, by D. R. Willis. Dec. 1960, 43p. incl. diagrs. table. (Technical note no. 2) (AFOSR-537) (AF 61-(052)348) AD 254999 Unclassified

It was suggested that information regarding surface interactions could be obtained by measuring the number flux of molecules reflected from a moving target. The possibility of determining $f_0(v')$, the distribution function of velocities of the emitted molecules relative to the target are considered, by this method. An integral equation for f_0 is obtained, but it is not of a type that can readily be classified, and it was not possible to prove anything analytically about the existence of solutions to the equation. Trial numerical solutions were made for the case when f_0 is a function of the speed v' only. The calculated values of f_0 were found to be very sensitive to the details of the numerical technique, and to any scatter in the values of the number flux. A method of determining the mean speed of the reflected molecules was found. This should not be very sensitive to scatter in the values of the number flux, and could be useful for testing the validity of proposed interactions. (Contractor's abstract)

2437

Rutgers U. Coll. of Engineering, New Brunswick, N. J.

X-RAY STUDY OF LATTICE DEFECTS IN FATIGUED SINGLE CRYSTALS, by A. Shrier, S. Weissmann, and J. J. Slade, Jr. July 1960 [55]p. incl. illus. diagrs. tables, refs. (Technical note no. 2) (AFOSR-TN-60-519) (AF 49(638)17) AD 239627 Unclassified

Annealed silver single crystals grown from the melt with a (111) orientation were subjected to cyclic bending and were studied below and above the fatigue limit (10^7 cycles). High resolution x-ray methods were employed which included the Schulz reflection topography method, the x-ray reflection microscopy method with continuous specimen rotation, the double-crystal diffractometer method supplemented by x-ray reflection microscopy, and the divergent x-ray beam back-reflection method. The x-ray studies were carried out as functions of increased number of cycles and position of specimen areas and were also supplemented by microhardness investigations. It was possible to discern 3 distinct stages in low-stress fatigue: a primary stage associated with cyclic work-hardening resulting from intersecting slip and the possible formation of Cottrell-Lomer locks; a secondary stage associated with a "softening" process and presumably with a partial "unlocking" of the Cottrell-Lomer locks; and a tertiary stage manifested by a characteristic x-ray line broadening and absence of a distinct substructural break-up. This tertiary stage was interpreted to be associated with submicroscopic void formation. In high-stress fatigue the effects of all the 3 stages were juxtaposed and the characteristic fatigue phenomena developed at a higher rate. (Contractor's abstract)

2438

Rutgers U. [Dept. of Mathematics, New Brunswick, N. J.]

THE SPHERICAL SUMMABILITY OF CONJUGATE MULTIPLE FOURIER-STIELTJES SERIES, by V. L. Shapiro. Feb. 16, 1960, 59p. (AFOSR-TN-60-213) (AF 18(600)1595) AD 234147; PB 146445 Unclassified

Operating in k-dimensional Euclidean space, $k \geq 2$, let $K(x)$ be a Calderon-Zygmund kernel in class $C^{(k + 5/2) + \epsilon}$ if k is even and in class $C^{(k + 3) + \epsilon}$ if k is odd, $\epsilon > 0$. Let $\hat{K}(y)$ designate the principal-valued Fourier transform of K. Also let $S[d\mu] = \Sigma a_m e^{i(m,x)}$ be a multiple Fourier-Stieltjes series, and call $\tilde{S}_K = \Sigma a_m \hat{K}(m) e^{i(m,x)}$ the conjugate of S with respect to the kernel K. Set $\tau_R^{\alpha}(x) = \Sigma_{|m| \leq R} a_m \hat{K}(m) e^{i(m,x)} (1 - |m|^2/R^2)^{\alpha}$, and $\tilde{\mu}(x) = (2\pi)^{-k} \lim_{t \to 0} \lim_{\lambda \to \infty} \int D(x, \lambda) - D(x,t) K(x - y)\, d\mu(y)$ wherever this limit exists, D(x,t) being the solid sphere with center x and radius t. The following result is obtained: For $\alpha > (k - 1)/2$, $\tau_R^{\alpha}(x) \to \tilde{\mu}(x)$ almost everywhere. This result is parallel to that of Bochner's for multiple Fourier-Stieltjes series (Trans. Amer. Math. Soc., v. 40: 175-207, 1936). (Contractor's abstract)

2439

Rutgers U. [Dept. of Mathematics] New Brunswick, N. J.

SURFACE SPHERICAL HARMONIC EXPANSIONS, by V. L. Shapiro. Mar. 13, 1960, 28p. incl. refs. (AFOSR-TN-60-339) (AF 18(600)1595) AD 235797; PB 146908 Unclassified

Questions related to the absolute convergence of surface spherical harmonic expansions on the n-sphere are discussed. The uniqueness of surface spherical harmonic expansions on the 2-sphere is also studied. The uniqueness problem is studied from the point of view of the order of growth of the moduli of the surface spherical harmonics, and best possible result in this direction is obtained. (Contractor's abstract)

2440

Rutgers U. [Dept. of Mathematics] New Brunswick, N. J.

DIFFERENTIAL FORMS OF BOUNDED p-VARIATION, by V. L. Shapiro. July 7, 1960, 26p. (AFOSR-TN-60-759) (AF 18(600)1595) AD 242713 Unclassified

Let ω be a continuous differential (n-1)-form defined in a bounded domain D of Euclidean n-space, $n \geq 2$, and let $C_i(0, 1)$, $i = 1,2$, represent two closed regular surfaces, each containing the origin in its interior and each of outer radius 1 with respect to the origin. Let the closed domain bounded by $C_i(0, 1)$ be designated $D_i(0, 1)$, and suppose that $D_i(0, 1)$ is starlike with respect to the origin, that $D_i(0, s)$ represents the member of the homothetic family with outer radius s, that $D_i(x, s)$ represents $D_i(0, s)$ translated to the point x, and that $C_i(x, s)$ is oriented with respect to the outer normal. Say that ω is of bounded p-variation with respect to C_i on D, $p = 1$, if there exists a constant K such that for every finite disjoint collection $\{D_i(x^j, s_j)\}_{j=1}^{k}$ with $D_i(x^j, s_j) \subset D$, the following fact holds: $\sum_{j=1}^{k} |D_i(x^j, s_j)|^{1-p} \left| \int_{C_i(x^j, s_j)} \omega \right|^p \leq K^p$ where $D_i(x^j, s_j)$ represents the n-dimensional volume of $D_i(x^j, s_j)$. Call the infimum of such K, $V_i(\omega, p)$. Say that ω is in Lip (1, p) with respect to C_i if there exists a constant K such that for all domains B whose closure is contained in D,

$$\limsup_{s \to 0} \int_B |D_i(x, s)|^{-p} \left| \int C_i(x, s) \omega \right|^p dx \leq K^p.$$

Call the infimum of such K, $W_i(\omega,p)$. The following result is then obtained:
$V_1(\omega,p) = V_2(\omega,p) = W_1(\omega,p) = W_2(\omega,p)$. (Contractor's abstract)

2441

Rutgers U. [Dept. of Mathematics] New Brunswick, N. J.

TOPICS IN FOURIER AND GEOMETRIC ANALYSIS, by V. L. Shapiro. [1960] [100]p. incl. refs. (AF 18(600)-1595) Unclassified

Published in Mem. Amer. Math. Soc., no. 39, 1961.

This report consists of 3 chapters in the Fourier analysis of functions of several real variables. Chapter 1 deals with the expansion of functions defined on the surface of the unit sphere in k-dimensional Euclidean space. Chapter 2 uses the results of Chapter 1 to obtain results in the spherical summability of conjugate multiple Fourier-Stieltjes series. The final chapter studies differential forms in Euclidean k-space by means of multiple Fourier series. (Contractor's abstract)

2442

Rutgers U. Dept. of Physics, New Brunswick, N. J.

NUCLEAR SPIN RELATION BY TRANSLATIONAL DIFFUSION. II. DIFFUSION IN A B.C.C. LATTICE, by H. C. Torrey. [1954] [1]p. incl. table. (AFOSR-5017) [AF 18(600)975] AD 416738 Unclassified

Also published in Phys. Rev., v. 96: 690, Nov. 1, 1954.

The calculation of nuclear spin relaxation time when relaxation is influenced by random-walk processes have been extended to the case of random walk to nearest neighbor positions in a body-centered cubic lattice. (Contractor's abstract)

2443

Rutgers U. Dept. of Physics, New Brunswick, N. J.

NUCLEAR MAGNETIC RESONANCE STUDY OF XENON, by R. L. Streever, Jr. and H. Y. Carr. Jan. 26, 1960 [27]p. incl. diagrs. tables, refs. (AFOSR-TN-60-106) (AF 18(603)6) AD 232621; PB 145840 Unclassified

Also published in Phys. Rev., v. 121: 20-25, Jan. 1, 1961.

The spin lattice relaxation time T_1 of Xe^{129} has been measured as a function of temperature in the liquid and pressure in the gas. A strong shift in the external resonant field at constant frequency but varying density has been discovered. For densities greater than 50 amagats this shift is 3.45 milligauss/amagat. The shift between a 48 atm gas sample at room temperature and a liquid sample at -75°C is 1.43 ± .06 gauss. The activation energy of the product of the density and T_1 in the liquid is 0.6 ± 0.1 kcal/mol. At room temperature between 48 atm and 73 atm, T_1 varies as the reciprocal of the density to the exponent 2.1 ± 0.4. The absolute values of the relaxation times are approximately 6 times longer than previously reported values. At 48 atm the experimental value of T_1 is 2600 ± 600 sec. The experimental values are compared with theory in the 2 limits, a dense liquid and a rare gas. A discrepancy of between 2 and 3 orders of magnitude exists. This indicates that the assumed nuclear dipole-dipole interaction is not the dominant relaxation mechanism. Other possibilities for this mechanism are discussed including its relationship to the observed shift. (Contractor's abstract)

2444

Rutgers U. Dept. of Physics, New Brunswick, N. J.

HIGH NEGATIVE NUCLEAR POLARIZATIONS IN SOLUTIONS OF FREE RADICALS, by L. H. Bennett and H. C. Torrey. Jan. 26, 1960 [16]p. incl. diagrs. table, refs. (AFOSR-TN-60-107) (AF 18(603)6) AD 232622; PB 145839 Unclassified

Negative proton polarizations up to 153 times the magnitude of the equilibrium polarization have been produced by partially saturating the electron spin resonance of naphthalene and anthracene free radical solutions. The proton polarization, observed by nuclear magnetic resonance with a phase sensitive detector, diminished, vanished, and then reappeared in the inverse sense, as a function of the saturation of the electron spin resonance. The observed values of the proton polarization were in excellent accord with the theory of the negative Overhauser effect given by A. Abragam (Phys. Rev., v. 98: 1729, 1955). The line width of the electron spin resonance line was measured as a function of the saturation factor by direct observation of the electron spin resonance and indirectly by means of the Overhauser effect. The electron spin resonance line is not broadened according to the usual theory of saturation broadening. The saturation behavior is probably due to inhomogeneous broadening of the electron spin resonance line, but no quantitative theory is presented to explain the saturation data. (Contractor's abstract)

2445

Rutgers U. [Dept. of Physics] New Brunswick, N. J.

A STUDY OF THE PROPERTIES OF MATTER BY MEANS OF NUCLEAR MAGNETIC RESONANCE TECHNIQUES. Dec. 1, 1955-Dec. 31, 1959. Jan. 26, 1960 [20]p. (AFOSR-TR-60-17) (AF 18(603)6) AD 232674; PB 146334 Unclassified

Absorption of energy from radiofrequency fields was measured by nuclear magnetic moments at resonance; the effects were studied on such absorption signals of the internal motions of atoms in simple systems, especially in such systems as metal hydrides, liquid water, and gaseous and liquid xenon. In other experiments enhancements of normal nuclear spin polarizations were induced by exciting resonances of electron spins coupled to the nuclear spins by dipolar interactions in several liquids and solids. The shapes and intensities were studied of continuous steady-state nuclear resonance signals as affected by application of pulsed radiofrequency power. Under some circumstances considerable improvement in sensitivity results from proper combinations of such sources. Under other circumstances it may be possible to obtain very narrow band filtering.

2446

[Rutgers U. Dept. of Physics, New Brunswick, N. J.]

[PART I] INVESTIGATION OF THE ENERGY LEVELS OF Ne^{19}, by F. G. Dunnington. [PART II] POLARIZATION OF 9 MEV PROTONS ELASTICALLY SCATTERED FROM MAGNESIUM, by A. B. Robbins. Final rept. [Jan. 7, 1960] 6p. incl. tables. (AFOSR-TR-60-8) (AF 18(603)140) Unclassified

Part I. Knowledge of the energy levels of Ne^{19} was sought through a study of the energies of the neutrons obtained from the reaction $F^{19}(p,n)Ne^{19}$. The neutron

energies were determined by the tracks of proton recoils occurring in nuclear emulsions placed at various angles with the target in proton beam. Early work was done with 18 mev protons obtained with the Princeton U. cyclotron, which produced an inadequate number of tracks in the available cyclotron time. The work was therefore transferred to the Brookhaven 60 in. cyclotron where currents up to 1 μa at about 10.4 mev were available. A total of 800 tracks were measured at a scattering angle of 90° and another 800 at 150°. The results for the Ne^{19} energy levels are summarized in tabular form and compared with measurements for the mirror nucleus F^{19}. Part II. For abstract of this work, see item no. 2447, Vol. IV.

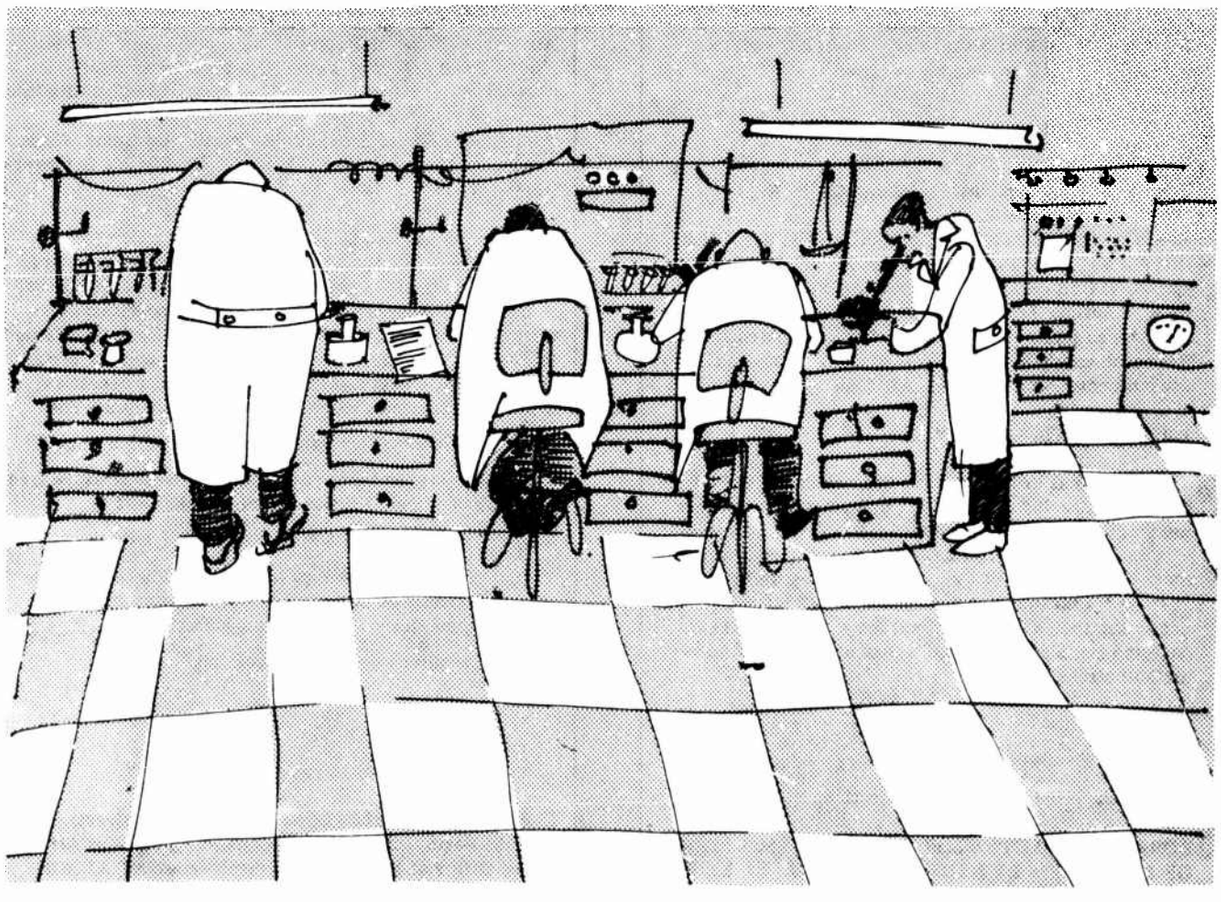
2447

Rutgers U. [Dept. of Physics] New Brunswick, N. J.

POLARIZATION OF 9-MEV PROTONS ELASTICALLY SCATTERED FROM MAGNESIUM, by A. B. Robbins and G. W. Greenlees. [1960] [5]p. incl. diagrs. tables, refs. (In cooperation with Birmingham U. (Gt. Brit.)) [AF 18(603)140] Unclassified

Published in Phys. Rev., v. 118: 803-807, May 1, 1960.

The polarization as a function of angle has been measured for protons elastically scattered from a 1-mev thick magnesium target with a mean energy of 9.1 mev. The resulting polarization distribution is compared to a differential cross section measurement with the same target.



2448

St. John's U. [Dept. of Physics] Jamaica, N. Y.

BORN CROSS SECTIONS FOR INELASTIC SCATTERING OF ELECTRONS BY HYDROGEN ATOMS. I. 3s, 3p, 3d STATES, by G. C. McCoyd, S. N. Milford, and J. J. Wahl. [1960] [5]p. incl. diagrs. tables, refs. (AFOSR-257) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)582 and Office of Naval Research under Nonr-260400) AD 250911 Unclassified

Published in Phys. Rev., v. 119: 149-153, July 1, 1960.

Born cross sections of all n = 3 to n = 4 transitions are calculated at ten incident electron energy values in the range 0.67-1400 ev, and those of strong optically allowed n = 3 to n = 5 transitions are calculated at five incident electron energy values in the range 1-10000 ev. The cross sections obtained are much larger than for comparable transitions from the ground state, and the cross sections for transitions which are optically allowed and in which n and l change in the same sense are larger than those for other transitions. For all strong optically allowed transitions the Bethe (dipole) approximations to the Born cross sections are calculated and comparison shows that the Bethe formula gives a good fit to the Born approximation down to relatively low energies (circa 10 ev). (Contractor's abstract)

2449

St. John's U. [Dept. of Physics] Jamaica, N. Y.

BORN CROSS SECTIONS FOR INELASTIC SCATTERING OF ELECTRONS BY HYDROGEN ATOMS. II. 4s, 4p, 4d, 4f STATES, by L. Fisher, S. N. Milford, and F. R. Pomilla. [1960] [3]p. incl. tables. (AFOSR-258) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)582 and Office of Naval Research under Nonr-260400) AD 250912 Unclassified

Published in Phys. Rev., v. 119: 153-155, July 1, 1960.

The Born total cross sections are calculated for the inelastic scattering of electrons by hydrogen atoms for the strong optically allowed transitions from n = 4 to n' = 5. The nine incident energies considered range from 0.546 ev to 1361 ev. In addition, the 4s to 6p and 4f to 6g transitions are considered. Bethe (multipole) cross sections are also calculated and found to reproduce the Born results down to low energies. (Contractor's abstract)

2450

St. John's U. [Dept. of Physics] Jamaica, N. Y.

BORN CROSS SECTIONS FOR INELASTIC SCATTERING OF ELECTRONS BY HYDROGEN ATOMS. III. 5s, 5p, 5d, 5f, 5g STATES, by S. N. Milford, J. J. Morrissey, and J. H. Scanlon. [1960] [3]p. incl. diagr. tables. (AFOSR-259) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)582 and Office of Naval Research under Nonr-260400) AD 250913 Unclassified

Published in Phys. Rev., v. 120: 1715-1717, Dec. 1, 1960.

Born total cross sections are computed for the strong optically allowed transitions from n = 5 to n' = 6, at incident energies between 0.2 ev and 1361 ev. Thirty energy values are considered for the 5s to 6p and 5g to 6h cases, and nine for the other transitions. The cross sections obtained are larger than those of comparable transitions for lower n. The Bethe (dipole) approximation is also used, and is found to give good agreement with the Born results down to relatively low energies (circa 3 ev). (Contractor's abstract)

2451

St. John's U. [Dept. of Physics] Jamaica, N. Y.

EFFECTS OF THE INTERSTELLAR WIND ON THE INTERPLANETARY PLASMA, by S. N. Milford. [1960] [6]p. incl. refs. (AFOSR-1444) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)582 and Office of Naval Research under Nonr-260400) Unclassifiedddd

Published in Proc. Eleventh Internat'l. Astronaut. Cong., Stockholm (Sweden) (Aug. 15-20, 1960), Vienna, Springer-Verlag, v. 1: 1-6, 1961.

It is pointed out that the interstellar gas which passes through the solar system may affect the interplanetary gas, planetary atmospheres, and the order of satellites. This paper discusses the interaction of the interplanetary and interstellar gases via atomic collisions. Using the results of zodiacal light observations and for ultraviolet rocket measurements, interplanetary densities near the earth are adopted as $n_e \sim 30$, $n_H \sim 0.2$. The fraction of interstellar gas of density n_1 which is captured as it passes through the solar system is expressed in terms of a fractional-capture parameter $(f_m)_{av}$. If $n_1(f_m)_{av}$ is of order 10^{-3} to 10^{-4} cm^{-3} then the interstellar gas contributes appreciably to the mass and energy of the interplanetary gas. A brief discussion of atomic scattering cross sections indicate that $n_1(f_m)_{av}$ is of the required order of magnitude.

2452

St. Johns's U. [Dept. of Physics] Jamaica, N. Y.

X-RAYS FROM COLLISIONS OF STARS (Abstract), by S. N. Milford. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF AFOSR-61-10 and Office of Naval Research) Unclassified

Presented at the 107th meeting of the Amer. Astronom. So'., New York, Dec. 29-31, 1960.

Published in Astronom. Jour., v. 66: 49, Mar. 1961.

The case of a star sliced exactly into 2 hemispheres is considered. The radiation from the surface of one half of a model star is integrated to give the total radiation. The calculated luminosities range from 10^{10} suns (k dwarf) to 10^{14} suns (B star), while the wavelength of maximum photon emission is in the range 2.0 to 6.5A. By assuming a stellar population similar to our galaxy, it is estimated that energetic B star collisions may occur about once per thousand years in a sphere of radius 3 billion parsecs. Collisions of stars in single galaxies within the same volume occur much more frequently, but most of these are not energetic enough to release comparable amounts of energy.

2453

St. Louis U. [Dept. of Physics] Mo.

SOLUTIONS OF A MODIFIED DIRAC EQUATION, by Z. V. Chraplyvy. Final technical rept. Nov. 15, 1960, 33p. (AFOSR-TR-60-172) (AF 49(638)567) AD 248448 Unclassified

The purpose of the present work is to compare the results obtainable from the Dirac equation with those from a "modified Dirac equation". For an electron in a central electrostatic field they read (in momentum representation) (1) $(E-mc^2\beta)\psi(\vec{p}) - c\alpha\cdot\vec{p}\,\psi(\vec{p}) = \frac{e^2}{2\pi^2\hbar}\int d^3k\ \frac{1}{k^2}\,\psi(\vec{p}+\vec{k})$; and (2) $(E-mc^2\beta)\psi(\vec{p}) - c\vec{\alpha}\cdot\vec{p}\,\psi(\vec{p}) = \left(\frac{1}{2} + \frac{mc^2\beta}{2\sqrt{m^2c^4+c^2p^2}}\right)\left(-\frac{e^2}{2\pi^2\hbar}\right)\int d^3k\ \frac{1}{k^2}\,\psi(\vec{p}+\vec{k})$, respectively. The latter was derived from the Bethe-Salpeter equation. It places the electron in a space with the negative energy states almost completely filled, whereas according to the old Dirac equation the electron tends to fall into 1 of them (unless prevented by an additional hypothesis). This constitutes the expected advantage of the modified equation over the old equation. On the other hand the results of the 2 equations must coincide insofar as they are borne out by experiment. These 2 points are checked by applying the equations to the Kepler problem and to the Klein problem. In each case the well-known results of the Dirac theory are first recalculated by a method which is is then found easy to apply to the modified equation.

2454

St. Louis U. [Dept. of Physics] Mo.

APPLICATION OF A REDUCED RELATIVISTIC WAVE EQUATION TO SPIN-LATTICE RELAXATION IN PARAMAGNETIC SALTS (Abstract), by R. J. Pendergast and W. A. Barker. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-612] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 252, Apr. 25, 1960.

As yet, no fully satisfactory theoretical treatment of spin-lattice relaxation in paramagnetic salts has been given. The object of the present work was to investigate more exhaustively than before possible relaxation mechanisms involving the interaction of one ion only with the lattice. To this end augmented relativistic one- and two-body wave equations were reduced to approximate form and the resulting terms combined in various ways. Those mechanisms which order of magnitude estimates indicated would be stronger were calculated more exactly for titanium and chrome alum, following the work of Van Vleck. The shortest relaxation time found exceeds the experimental value by 10^4 and has the same incorrect field dependence as Van Vleck's. It seems, therefore, that unexplained features of spin-lattice relaxation are not due to any overlooked mechanism involving the interaction of only one ion with the lattice.

2455

San Andres U. Laboratorio de Fisica Cosmica de Chacaltaya, La Paz (Bolivia).

[DAILY VARIATION OF COSMIC RAY INTENSITY MEASURED WITH DIRECTIONAL TELESCOPES AT CHACALTAYA] Variaciones diarias de la intensidad de los rayos cosmicos medida con telescopios direccionales en Chacaltaya, by I. Escobar, C. Urfa, and R. Weil. [1959] [15]p. incl. diagrs. tables. (AFOSR-TN-60-765) (AF 49(638)290) Unclassified

Also published in Rev. Mex. Fis., v. 8: 101-115, 1959.

Summary also published in Resumen de Labores, 1960, La Paz (Bolivia), Laboratoria de Física Cósmica, Mar. 1961, p. 8-12.

An experiment is being carried out in Chacaltaya with two twin telescopes, without absorbant and directed at 45° east and west. It is concluded from the study of 5 months data that the principal factor in the observed variation is due to the pressure fluctuations. Realizing the barometric correction and on the other side, eliminating the meteorological factors and taking the difference of the east and west telescopes, a variation results daily

of the primary radiation of the order of 0.3% with a maximum at 12 a.m. and a minimum at 8 p.m. The data seem to indicate that the primary particles of low energy that cause the radiation registered in the west telescope are scattered by extraterrestrial magnetic fields.

2456

San Andres U. Laboratorio de Fisica Cosmica [de Chacaltaya] La Paz (Bolivia).

COSMIC RAYS INTENSITY CHANGES NEAR THE GEOMAGNETIC EQUATOR DURING JULY 1959, by I. Escobar, E. Maldonado and others. [1959] [9]p. incl. diagrs. table. (AFOSR-TN-60-1341) (AF 49(638)290) AD 247587 Unclassified

Presented at Midwest Cosmic Ray Conf., Iowa U., Iowa City, Oct. 30-31, 1959.

Also published in Jour. Geophys. Research, v. 65: 1385-1390, May 1960. (Title varies)

Cosmic-ray meson intensity at Chacaltaya (elevation 5220 m above sea level and magnetic latitude 4°S) registered a 9.5% decrease during 3 magnetic storms of July 1959. In addition a small increase of 1 to 2% was observed in association with the first and last storms which commenced at Chacaltaya at about noon. These features are discussed in relation to different magnetic field structures contained in the ionized gas ejected by the sun, and it is shown that the gas had partly turbulent and partly coherent magnetic fields in it when it arrived in the earth's vicinity. (Contractor's abstract)

2457

San Andres U. Laboratorio de Fisica Cosmica de Chacaltaya, La Paz (Bolivia).

OBSERVATIONS OF EXTENSIVE AIR SHOWERS NEAR THE MAXIMUM OF THEIR LONGITUDINAL DEVELOPMENTS, by J. Hersil, I. Escobar and others. [1960] [6]p. incl. diagrs. (AFOSR-465) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)290, Atomic Energy Commission, M.I.T. Computation Center, and Office of Naval Research) AD 254041 Unclassified

Presented at Symposium on Space Research, Buenos Aires (Argentina), Nov. 28-Dec. 3, 1960.

Also published in Phys. Rev. Ltrs., v. 6: 22-23, Jan. 1961.

Also published in Resumen de Labores, 1960, La Paz (Bolivia), Laboratorio de Fisica Cósmica, Mar. 1961, p. 43-46.

Extensive air showers were studied at an altitude of 4200 m with apparatus previously used at sea level. Their characteristics are found to differ markedly from those of showers at sea level, and demonstrate that vertical showers with about 30 million particles are near their maximum development. These results were derived from data on approximately 400 selected showers with sizes greater than 15 million particles. (Contractor's abstract)

2458

San Andres U. Laboratorio de Fisica Cosmica de Chacaltaya, La Paz (Bolivia).

ON SOME CHARACTERISTICS OF SOLAR EMISSION OF IONISED MATTER, by I. Escobar, N. W. Nerurkar and others. [1960] [9]p. incl. diagrs. tables. (AFOSR-466) (AF 49(638)290) AD 254042 Unclassified

Presented at Symposium on Space Research, Buenos Aires (Argentina), Nov. 28-Dec. 3, 1960.

Also published in Resumen de Labores, 1960, La Paz (Bolivia), Laboratorio de Fisica Cósmica, Mar. 1961, p. 47-49.

Geomagnetic storms are caused by the arrival at the earth of solar ionized matter, which is believed to be emitted simultaneously with a sudden outburst of activity on the sun. When such outbursts are associated with a type of IV burst in solar noise, the emitted matter contains magnetic fields and subsequent storms are accompanied by a decrease in cosmic ray intensity. These decreases are not confined to the immediate vicinity of the earth but extend to distances as far as 8 million km from the earth. Variations in cosmic ray intensity can therefore be used as a probe to derive some of the characteristics of the solar emission. A preliminary report of a study of this nature is presented. (Contractor's abstract, modified)

2459

San Andres U. Laboratorio de Fisica Cosmica de Chacaltaya, La Paz (Bolivia).

COSMIC RAY INTENSITY VARIATIONS DURING THE MAGNETIC STORM OF NOVEMBER 1960, by I. Escobar, N. W. Nerurkar and others. [1960] [4]p. incl. diagrs. (AFOSR-467) (AF 49(638)290) Unclassified

Presented at Symposium on Space Research, Buenos Aires (Argentina), Nov. 28-Dec. 3, 1960.

Data is presented on the intensity of cosmic radiation observed at Chacaltaya (altitude 5220 m above sea level), geomagnetic latitude 5° S), during the magnetic storm of Nov. 1960. The following instruments were used: a neutron monitor, a meson vertical telescope and a pair of telescopes of total intensity pointed in the east and west azimuthal direction with a zenith angle of 45°. The magnetic storm began Nov. 12 at 0950 local time. The intensity of the cosmic radiation showed an increase of approximately 1% about 5 or 6 hr later. The continuation of the storm produced a decrease of the Forbush type.

2460

San Andres U. Laboratorio de Fisica Cosmica [de Chacaltaya] La Paz (Bolivia).

TIME VARIATIONS IN COSMIC RAYS. I. CHARACTERISTICS OF EXTENSIVE AIR SHOWERS. II., by I. Escobar. Final progress rept. 1960 [107]p. incl. illus. diagrs. tables, refs. (AFOSR-1545) (AF 49(638)290) Unclassified

The results in Part I deal with cosmic variations (1) prior to the onset of Forbush event, (2) during the main phase of the decrease, and (3) while cosmic ray intensity is recovering. An effort has been made to look for unusual phenomena in association with Forbush decreases. In addition, some exceptional cases of Forbush decreases which show a difference in onset times are given. In Part II the operation of the eleven detectors of the preceding experiment at El Alto are given in addition to the density spectrum of the showers detected. Experimental results concerning the lateral distribution, size spectrum, and the celestial arrival direction of showers are presented. (Contractor's abstract, modified)

2461

San Andres U. Laboratorio de Fisica Cosmica de Chacaltaya, La Paz (Bolivia).

SIDEREAL ANISOTROPY OF HIGH ENERGY COSMIC RAYS. II., by I. Escobar, N. [W.] Nerurkar, and R. Weil. [1959] [6]p. incl. diagrs. tables. [AF 49(638)290] Unclassified

Published in Planetary and Space Sci., v. 2: 187-192, Apr. 1960.

A report is made of the results obtained from a second period of operation of an extensive shower monitor located at Chacaltaya, Bolivia. The results are consistent with those obtained during the first period of operation, namely, a variation of the order of 1% at 19.0 local Sidereal Time for the high energy showers, and no variation for the low energy showers recorded. It is shown that the pressure correction does not affect these results. (Contractor's abstract)

2462

San Andres U. Laboratorio de Fisica Cosmica de Chacaltaya, La Paz (Bolivia).

[REGIONAL CENTERS OF SCIENTIFIC INVESTIGATION] Centros regionales de investigacion cientific, by I. Escobar. [1960] [11]p. [AF 49(638)290] Unclassified

Presented at the Seminar about Development and Organization of Scientific Research in Latin America, Caracus (Venezuela), Oct. 3-7, 1960.

Published in Bull. of Information of the Center of Scientific Cooperation of UNESCO for Latin America, no. 26, Montevideo (Uruguay), 1961.

An analysis of regional centers for scientific investigation is presented. Emphasis is placed on the need for and formation of these subcommittees.

Sarah Mellon Scaife Radiation Lab., Pittsburgh, Pa. see Pittsburgh U. Sarah Mellon Scaife Radiation Lab., Pa.

Sibley School of Mechanical Engineering, Ithaca, N. Y. see Cornell U. Sibley School of Mechanical Engineering, Ithaca, N. Y.

2463

Siena U. Inst. of Pathology (Italy).

[ELECTRICAL STIMULATION OF BULBO-PONTINE TEGMENTUM IN THE ACUTE THALAMIC CAT] Effetti della stimolazione del tegmento bulbo-pontino nel gatto talamico acuto, by J. Apelbaum, E. Bizzi and others. [1960] [3]p. (AFOSR-1252) (Sponsored jointly by Air Force [Office of Scientific Research] under AF 61(052)-253 and Rockefeller Foundation) AD 262140 Unclassified

Presented at Twenty-ninth General meeting of the Ital. Soc. for Exper. Biol., Oct. 6-8, 1960.

Also published in Boll. Soc. Ital. Biol. Sper., v. 36: 1537-1539, 1960.

The following effects were elicited by electrical stimulation of the lateral bulbo-pontine tegmentum through stereotactically oriented electrodes: (a) postural reactions, (b) sham rage outbursts, whenever the stimulation intensity or repetition rate was below threshold for postural movements, and (c) rebound outbursts of sham rage at the end of stimulation inducing postural reactions. The following effects were obtained by stimulation of the medial bulbo-pontine tegmentum: (a) postural reactions, (b) sham rage outbursts, upon stimulations inducing no or slight postural effects, (c) inhibition of spontaneous or peripherally evoked sham rage outbursts, also upon stimulations inducing no or slight postural effects, and (d) rebound outbursts of sham rage. The contribution of fibers from the cerebellum and coursing through the brain stem is also discussed.

2464

Siena U. [Inst. of Pathology] (Italy).

REFLEX CHEMOCEPTIVE EXCITATION OF DIENCEPHALIC SHAM RAGE BEHAVIOR, by E. Bizzi, A. Libretti and others. [1960] [4]p. incl. illus. refs. (Sponsored jointly by Air Force Office of Scientific Research

under AF 61(052)253, Rockefeller Foundation, and Wright Air Development Center) Unclassified

Published in Amer. Jour. Physiol., v. 200: 923-926, May 1961.

In acute thalamic cats, excitation of the carotid body chemoceptors was induced by intrasinusal injection of lobeline or by administering low oxygen mixtures. Bilateral section of the cervical vagoaortic trunks, preliminary to the experiment, permitted the exclusion of the aortic chemoceptive areas from the study. Stimulation of the carotid body chemoceptors was constantly capable of evoking sham rage outbursts identical in pattern and intensity to those induced by tactile or noxious stimulation or occurring spontaneously. When low-intensity stimulation was used the rage fits were preceded in time by signs of excitation of the medullary respiratory and vasomotor centers. Since lobeline and hypoxia became unable to evoke sham rage outbursts following selective inactivation of the carotid body chemoceptors, it is concluded that the diencephalic mechanisms for rage behavior are within the sphere of influence of chemoceptive reflexes. (Contractor's abstract)

Sloane Physics Lab., New Haven, Conn. see Yale U. Sloane Physics Lab., New Haven, Conn.

2465

Societe Francaise d'Etudes et de Realisations d'Inventions Coanda, Clichy (France).

STUDY OF A COANDA NOZZLE OPERATING AS A SINGLE EJECTOR. STUDY OF THE OPERATION OF COANDA NOZZLE WORKING IN STAGES. EXTRAPOLATION LAWS. Final technical rept. Aug. 1959, 1v. incl. illus. diagrs. tables. (AFOSR-TR-60-2) (AF 61-(052)158) AD 230385 Unclassified

This research relates to experimental and theoretical work on the ejector nozzle with particular reference to the Coanda effect. The work has included investigation of (1) the single Coanda nozzle working as an ejector, and its comparison with a direct ejector; (2) the Coanda nozzle working as a compressor; (3) the theoretical considerations of the nozzle set up in stages; (4) the extrapolation laws; and (5) nozzle 70/84 working as a single ejector and as a compressor. Experimental data and results are presented.

2466

South Carolina U. Dept. of Chemistry, Columbia.

INTRAMOLECULAR FREE RADICAL ARYLATION AND RELATED REACTIONS, by D. F. DeTar and C.-C. Chu. [1960] 24p. incl. diagrs. tables, refs. (AFOSR-TN-60-157) (AF 49(638)88) AD 231250; PB 147346 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 4969-4974, Sept. 1960.

The reactions of the 2-o-terphenyl free radical as obtained both from the peroxide of o-terphenyl-2-carboxylic acid and from the diazonium salt derived from 2-amino-o-terphenyl were studied. Cyclization to triphenylene (IX) occurs to the exclusion of the intermolecular reaction with benzene or with carbon tetrachloride. However, bromine abstraction from bromotrichloromethane does compete with cyclization. This behavior is in contrast to that of the o-benzoylphenyl radical, which was found in previous work to give a higher yield of 2-phenylbenzophenone by intermolecular reaction with benzene than of the intramolecular cyclic product, fluorenone. The peroxide of o-(1-naphthyl)-benzoic acid (VI) was also investigated, but the acyloxy radical failed to decarboxylate. The main product found was the lactone (VIII) of o-(2-hydroxy-1-naphthyl)-benzoic acid. (Contractor's abstract)

2467

South Carolina U. Dept. of Electrical Engineering, Columbia.

APPLICATIONS OF A DIELECTRIC SHEET HALF-REFLECTING MIRROR AT MILLIMETER WAVELENGTHS, by R. G. Fellers. Jan. 2, 1960, 24p. incl. illus. diagrs. (AFOSR-TN-60-14) (AF 18(603)-43) AD 231665; PB 145789 Unclassified

A free-space transmission system was investigated as a possible low-loss replacement for waveguide over within system distances. In the use of such a scheme, it is necessary to devise the free-space equivalent of a number of waveguide components including the magic-tee, the wavemeter, the standing wave indicator and the duplexer. A dielectric sheet of appropriate thickness can be made to act as a half-silvered mirror and hence to serve the purpose of a magic-tee or three decibel directional coupler. Using this unit, a duplexer can be constructed and a Michelson interferometer can be built which will perform the functions of a wavemeter and a standing wave indicator. (Contractor's abstract)

2468

South Carolina U. Dept. of Electrical Engineering, Columbia.

CYLINDRICAL REFLECTORS FOR DIRECTING AND CONCENTRATING MICROWAVE BEAMS, by R. G. Fellers and F. E. Rouffy, Jr. Apr. 1, 1960, 50p. incl. diagrs. tables, refs. (AFOSR-TN-60-427) (AF 18(603)-43) AD 237565; PB 148026 Unclassified

The straight-line transmission performance of a full-paraboloidal microwave antenna transmission system at 35.3 kmc was investigated theoretically and experimentally. To determine if the performance of this free transmission system could be improved, 4 cylindrically

shaped aluminum-foil-surfaced reflectors were designed, constructed, and placed mid-way in the transmission path so as to effect a 90° corner-reflection of a transmitted beam, and in so doing to concentrate the beam in order to obtain a power gain over straight-line transmission. At the total transmission distances, D^2/λ, $2D^2/\lambda$, $4D^2/\lambda$ (36 ft, 72 ft, 144 ft), transmission losses with a plane reflector were compared with the straight-line transmission losses; within meter accuracy (± 0.2db) these losses were measured as equal. Power gains resulting from the use of the cylindrically curved reflectors were then measured as gains over plane reflector transmission. Within the discrete range of transmission total distance, the min power gain was measured as 2.8 db at D^2/λ. The max power gain was measured as 5.3 db at $4D^2/\lambda$. Empirical rules were made for estimating the gain produced by the various curved reflectors. Design equations and considerations are presented for the construction of curved reflectors. (Contractor's abstract)

2469

South Carolina U. [Dept. of Electrical Engineering] Columbia.

MILLIMETER WAVES AND THEIR APPLICATIONS, by R. G. Fellers. [1956] [4]p. incl. illus. diagrs. refs. (AFOSR-3927) [AF 18(603)43] Unclassified

Also published in Elec. Eng., v. 75: 914-917, Oct. 1956.

The 30,000-300,000 mc frequency range is investigated. It is shown that this wavelength range can accommodate many communications services, especially where there is need for high-gain, high-directional antennas, and large bandwidth.

2470

Southern California U. Dept of Chemistry, Los Angeles.

THE HYDRATION OF exo-cis-3,6-ENDOMETHYLENE-Δ^4-TETRAHYDROPHTHALIC ANHYDRIDE, by J. A. Berson and S. Suzuki. [1960] [5]p. (AFOSR-TN-60-53) (AF 18(600)1544) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 80: 4341-4345, Aug. 20, 1958.

The hydration reaction of the title gives exo-4-hydroxy-exo-cis-3,6-endomethylenehexahydrophthalic acid. The structure of the product is proved by alternate synthesis from exo-4,5-epoxy exo-cis-3,6-endomethylenehexahydrophthalic anhydride. (Contractor's abstract)

2471

Southern California U. [Dept. of Chemistry] Los Angeles.

THE CHEMISTRY OF BRIDGED BICYCLIC SUBSTANCES, by J. A. Berson. Final rept. Feb. 1, 1960 [3]p. (AFOSR-TR-60-114) (AF 18(600)1544) Unclassified

The principal experimental results and theoretical conclusions of this study are summarized. The general area of effort has been that of organic reaction mechanism and stereochemistry. The experimental systems examined involved derivatives of bicycles (2.2.1) heptane. The results are embodied in 6 published papers, listed at the end of the report. (See also item nos. SOC.03:001, 002, Vol. I; SOC.03:003, 004, Vol. II; 1916, Vol. III; and 2470, Vol. IV.) The work has been grouped into 3 major categories: (1) studies of electronic delocalization in rearrangement reactions of norbornyl derivatives, (2) studies of free radical rearrangements, and (3) investigation of the structure of the hydration product of exo-cis-3,6-endomethylene-Δ^4-tetrahydrophthalic anhydride.

2472

Southern California U. Dept. of Chemistry, Los Angeles.

A FREE RADICAL WAGNER-MEERWEIN REARRANGEMENT, by J. A. Berson, C. J. Olsen, and J. S. Walia. [1960] [2]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1544, Alfred P. Sloan Foundation, Office of Ordnance Research under DA 04-495-ORD-532, and Richfield Oil Corp.) Unclassified

Published in Jour. Amer. Chem. Soc., v. 82: 5000-5001, Sept. 20, 1960.

This is a preliminary report of a study of a system in which alkyl group migration is observed. The bornyl radical (I), the decarbonylation product of 2-camphanecarboxaldehyde (II) with tert-butyl peroxide at 140-150°, gives mainly the unrearranged product, camphane (III). Generation of I by decomposition of 2,2'-azocamphane (IV) at 255-290° yields among other products some isocamphane (V)(structurally related to II in the Wagner-Meerwein sense) as well as III and p-menthene (VI). The formation of VI at higher temperature suggests that I undergoes ring opening by β-elimination. Evidence is offered to show that V is obtained from I by a similar process. 2,2'-Azo-(1,5,5-trimethyl-4-ethyl-1-cyclopentenylethane) (VII) was prepared by the following route. α-Pinene oxide → campholenealdehyde (VIII) → campholenealdehyde azine, b.p. 164-166° (1.5 mm), $n^{25}D$ 1.5028 → corresponding hydrazine → VII, b.p. 150-152° (1.5 mm) $n^{25}D$ 1.4858, λ_{max} 360 mμ log ε 1.47. Wolff-Kishner reduction of VIII gives 1,5,5-trimethyl-4-ethyl-cyclopentene (IX), b.p. 68-68.5° (43 mm), $n^{25}D$ 1.4429. IX forms two nitrosochlorides, m.p. 95-96°, and 122.5-123°. The thermal decomposition of VII qualitatively gives the same products obtained from II: VI, III,

V, bornylene, tricyclene and IX. Identification and estimation of products are made by gas chromatography, examination of the isolated fraction by infrared spectrum, and separation of olefins on silica gel. This formation of IV from II is the first clear example of an intramolecular free radical alkyl group rearrangement.

2473

Southern California U. Dept. of Chemistry, Los Angeles.

BLACK SOAP FILMS, by J. Th. G. Overbeek. [1960] [6]p. incl. diagrs. refs. (AFOSR-TN-60-821) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)309 and Petroleum Research Fund) AD 247463 Unclassified

Presented at Thirty-fourth Nat'l. Colloid Symposium, Lehigh U., Bethlehem, Pa., June 16, 1960.

Also published in Jour. Phys. Chem., v. 64: 1178-1183, Sept. 1960.

During the aging of colored soap films, black spots are formed which are ultrathin parts of the film. They are usually separated from the colored part of the film by a sharp transition and grow spontaneously. The principal forces that govern their thickness are the electrostatic repulsion between the soap ions on the 2 faces of the film and van der Waals attraction among all the molecules of the film. It is essential to take into account the fact that the electrostatic repulsion acts only across the water layer of the film, whereas the water layer and the soap molecules both contribute to the van der Waals forces. The equilibrium thickness of the black films presumably is determined by these forces and by the border suction (surface tension divided by the radius of curvature of the border surface). The rate of formation of black films depends on these forces and on the viscous resistance in the film. An extension of Frankel's theory on the rate of film formation is presented, which takes the influence of electrostatic and van der Waals forces into account. In films formed from solutions of nonionic detergents both electrostatic repulsion and steric repulsion play a role. Black films do not break spontaneously but breaking may be caused by a number of effects, e.g., evaporation, dewetting of impurities, local heating. (Contractor's abstract)

2474

Southern California U. Dept. of Chemistry, Los Angeles.

THE MEASUREMENT OF FILM ELASTICITY, by K. J. Mysels, M. C. Cox, and J. D. Skewis. [1960] [5]p. incl. illus. diagrs. table. (AFOSR-TN-60-1176) (AF 49-(638)309) AD 264081 Unclassified

Also published in Jour. Phys. Chem., v. 65: 1107-1111, July 1961.

The elasticity modulus of soap films as defined by Gibbs (Trans. Conn. Acad. Arts Sci., v. 3: 108, 343, 1876) was measured for the first time. The method involves simultaneous determination of the change in the surface tension acting upon a film under observation and of the motion of the interference fringes which this produces. The force acting upon the film is determined as part of the total force acting upon a vertical frame supporting this film in contact with the solution. The changes in surface tension are produced by rapidly withdrawing another film-forming frame from the solution, thus increasing greatly the total surface. The motion of the fringes is recorded photographically and is then translated into the motion of the surface elements on the assumption that the volume of liquid within the film remains constant. Details and limitations of this procedure are discussed. For a number of mobile films the modulus of elasticity is of the order of 10 dynes/cm, while for a rigid film of sodium lauryl sulfate-lauryl alcohol solution it is of the order of 100 dynes/cm. (Contractor's abstract)

2475

Southern California U. Dept. of Chemistry, Los Angeles.

A NITROGEN ANALOG OF SESQUIFULVALENE, by J. A. Berson, E. M. Evleth, and Z. Hamlet. [1960] [2]p. incl. table, refs. (AFOSR-TN-60-604) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)828 and Office of Ordnance Research under DA-04-495-ORD-532) Unclassified

Published in Jour. Amer. Chem. Soc., v. 82: 3793-3795, July 20, 1960.

The synthesis of 2-cyclopentadienylidene-1-methyl-1,2-dihydropyridine, (I), a simple nitrogen analog of sesquifulvalene, is described. One mol of 2-bromopyridine methiodide in 2 mol of 1,2-dimethoxyethane reacts with 2 mol of Na-cyclopentadienide to give 31% of (I), orange needles from ether or hexane, obtained in 2 dimorphic modifications (form A of m.p. 56-57°C to form B by seeding of identical infrared and ultraviolet spectra). The means used to establish the compound structure is described. It appears to be the first simple sesquifulvalene analog of proven structure. Compound (I) gives a colorless solution (λ_{max} 342, no shoulder at 410-425 mu) in ethanolic perchloric acid, signifying conversion to the conjugate acid; the change is quantitatively reversed by alkali, even after storage of the acidic solution. The unstable crystalline perchlorate of (I) is obtained as needles (from ethyl acetate-ethanol) which decompose above about 80°C. It shows no $\equiv^{+}$ N-H absorption in the infrared (KBr disc). Further properties and reactions of (I) and related substances are being investigated.

2476

Southern California U. Dept. of Electrical Engineering, Los Angeles.

MICROWAVE MEASUREMENT OF ELECTRON

DENSITY DISTRIBUTIONS IN PLASMA COLUMNS, by G. E. Stewart and Z. A. Kaprielian. July 29, 1960, 41p. incl. diagrs. (USCEC rept. no. 79-201) (AFOSR-TN-60-927) (AF 49(638)522) Unclassified

Also published in Proc. Fifth Internat'l. Conf. on Ionization Phenomena in Gases, Munich (Germany) (Aug. 28-Sept. 1, 1961), Amsterdam, North-Holland Publishing Co., 1962, p. 395-404.

Numerous applications of the arc discharge tube in the study of plasmas require some knowledge of the electron density as a function of position in the tube. In general, the region of the discharge called the positive column is used for studying the properties of this plasma. In the positive column the electron density is independent of axial or longitudinal coordinates, but does vary with the radius. A method is described for explicitly representing the radial dependence of the density in terms of a series of orthogonal polynomials of the radius, the coefficients of which are evaluated by the shift in frequency of resonance of microwave cavity modes. (Contractor's abstract)

2477

Southern California U. Dept. of Electrical Engineering, Los Angeles.

PLASMA PARAMETRIC AMPLIFIER, by J. Y. Wada and Z. A. Kaprielian. Sept 1960, 53p. incl. diagrs, refs. (USCEC rept. no. 79-202) (AFOSR-TN-60-1261) (AF 49(638)522) AD 247170 Unclassified

The theory and application of plasmas as nonlinear reactance elements in parametric amplifiers are presented in this paper. The feasibility of parametric amplification is demonstrated by use of a quadrupole cavity model containing a plasma column. Analytical expressions for the power gain and noise figure are derived for the case in which the signal and idling frequencies are sufficiently separated and for the degenerate case in which these 2 frequencies are equal. The results and their limitations are discussed in some detail. (Contractor's abstract)

2478

Southern California U. Engineering Center, Los Angeles.

TRANSPORT PHENOMENA OF A RAREFIED AND FULLY IONIZED GAS IN THE PRESENCE OF A STRONG MAGNETIC FIELD. PART II, by T. Koga. Feb. 12, 1960, 18p. incl. diagrs. (USCEC rept. no. 56-210) (AFOSR-TN-60-103) (AF 18(603)95) AD 233080; PB 146719 Unclassified

A generalization of the theory of the diffusion of a fully ionized gas confined in a strong magnetic field is given by a general definition of macroscopic variables. The results are given in terms of these moments. The effects of drifts of particles caused by the spatial inhomogeneity of a magnetic field and/or by an electrostatic field accompanying a uniform magnetic field are considered. It is concluded that the implication of the Boltzmann equation is too wide or unconditional to yield satisfactory general equations of macroscopic variables which cover all the phenomena of gasdynamics. A special choice of macroscopic variables must be made for each case.

2479

Southern California U. Engineering Center, Los Angeles.

INTERACTIONS OF RAPIDLY MOVING BODIES IN TERRESTIAL ATMOSPHERE, by K. P. Chopra. Mar. 31, 1960, 147p. incl. illus. diagrs. tables, refs. (USCEC-rept. no. 56-212) (AFOSR-TN-60-398) (AF 18(603)95) AD 236347; PB 147300 Unclassified

The phenomena concerning the interactions of rapidly moving bodies in an ionized medium pervaded by a magnetic field are described. This study has a special bearing on the motion of artificial earth satellites. The first category of phenomena concerns the interaction of the body with neutral particles. The second group of phenomena deals with the generation of electrical currents induced in the moving body or the surrounding medium (or both) by the relative motion of the conducting material and the magnetic field. These currents result in the decay of the linear motion and the spin of the body, and also in the precession of the spin leading to the tumbling of the body. The third class of phenomena is due to the body's acquiring an electric charge due to the accretion of charged particles and the photoelectric effect of the solar radiation, and the consequent Coulomb interactions between the charged body and the charged particles. This interaction results in the momentum transfer between the body and the charged particles. The motion of the charged body in the terrestrial atmosphere is capable of exciting various wave phenomena. Three kinds of waves are described: (1) plasma oscillations in the wake of the body, (2) extraordinary electromagnetic waves, and (3) magnetohydrodynamic waves due to the interaction between the induced motion of an ionized column ahead of the body and the transverse component of the terrestrial magnetic field. (Contractor's abstract)

2480

Southern California U. Engineering Center, Los Angeles.

A SEMI-AUTOMATIC McLEOD GAUGE, by H. R. Pass. Mar. 31, 1960, 36p. incl. illus. diagrs. (USCEC rept. no. 56-211) (AFOSR-TN-60-399) (AF 18(603)95) AD 236348; PB 147299 Unclassified

A semi-automatic McLeod gauge was designed and built for use in a low-density wind tunnel. The gauge is mounted inside the tunnel and is remotely controlled and remotely read. Control is obtained by means of an electro-pneumatic circuit using electrodes that are

inserted through the glass walls; the reading is obtained electrically using a circuit consisting of, in part, a constant-current generator, tungsten wires that are placed in the bores of the capillaries, and a strip-chart recorder. The design is relatively simple, inexpensive, and reliable although, operationally, it is somewhat unwieldy, particularly with regard to the adjustment of the pressure regulator and time-to-fill at the 50 μ range. (Contractor's abstract)

2481

Southern California U. Engineering Center, Los Angeles.

REDUCTION OF THE BOUNDARY LAYER THICKNESS IN A HYPERSONIC NOZZLE, by S. A. Walter. May 20, 1960, 22p. incl. diagrs. (USCEC rept. no. 56-213) (AFOSR-TN-60-514) (AF 18(603)95) AD 238122; PB 148355 Unclassified

The reduction of the boundary layer thickness in a hypersonic nozzle can be realized by cooling the walls. In this way, an important heat transfer from the flow is created, increasing the density in the boundary layer. The integration of the mass flow equation will show the influence of the wall temperature on the boundary layer thickness. Applications to specific cases are proposed for a given nozzle. The following results are observed: (1) the power needed for cooling the nozzle is low and (2) this power varies slowly with the wall temperature (if $T_w < 200°K$) but decreases with the Reynolds number and the stagnation temperature for a given Mach number. Charts are given for $8 \leq M \leq 18$ and for stagnation temperature $T_s \leq 2000°K$. For higher temperatures, dissociation and ionization appear so the problem must be solved for each special case: the general heat transfer equation is given and its application is easy if the stagnation conditions and the local Mach number are known. (Contractor's abstract)

2482

Southern California U. Engineering Center, Los Angeles.

STUDIES IN THE HEATING OF A SUPERSONIC GAS STREAM BY A RADIO FREQUENCY DISCHARGE, by F. O. Smetana. July 15, 1960, 87p. incl. illus. diagrs. tables, refs. (USCEC rept. no. 56-214) (AFOSR-TN-60-648) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)95, Arnold Engineering Development Center under AF 49(600)857, and Office of Naval Research) AD 604193; PB 149958 Unclassified

The background and problem areas of the application of radio frequency discharge to heating a supersonic gas stream are discussed. An apparatus was constructed to permit the effectiveness of this technique to be studied by calorimetry. Results indicate that about 10% of the power taken from the ac line appeared as heat in the gas. Through modifications in the electrical circuitry this probably can be increased to 15%. This technique introduces a negligible percentage of unwanted contaminants. On the other hand, small quantities of C_4F_8 mixed with N_2 were found to decrease the N_2 recombination time substantially. Tests were also made using argon alone and mixed nitrogen. Maximum gas temperatures at the end of the nozzle were obtained with argon alone, being 660°K. Limited spectroscopic and microwave interferometer investigations were also conducted. (Contractor's abstract)

2483

Southern California U. Engineering Center, Los Angeles.

OPERATION AND CALIBRATION OF THE LOW DENSITY WIND TUNNEL, by R. L. Chuan, L. M. Springer, and S. A. Walter. July 15, 1960, 39p. incl. illus. diagrs. (USCEC rept. no. 56-215) (AFOSR-TN-60-649) (AF 18-(603)95) AD 240844; PB 149959 Unclassified

A low density wind tunnel was developed which is capable of producing flows at lower density, higher Mach numbers, higher temperature, and with a larger flow field than was possible in the past. Slip, transitional and free molecule flows can be studied with large regions of interest susceptible to probing with appropriate instruments and with flow durations sufficiently long to ensure equilibrium conditions in all measurements. Various aspects of the facility, operational characteristics of the tunnel, and the results of flow calibration at M = 8 are presented. (ASTIA abstract)

2484

Southern California U. Engineering Center, Los Angeles.

MOMENT EQUATIONS AND BOUNDARY CONDITIONS FOR MAGNETO-GAS DYNAMICS, by H.-T. Yang. July 29, 1960, 51p. incl. diagr. refs. (USCEC rept. no. 56-216) (AFOSR-TN-60-963) (AF 18(603)95) AD 244124 Unclassified

Presented at meeting of the Amer. Phys. Soc., Honolulu, Hawaii, Aug. 27-29, 1959.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 4: 352, Aug. 27, 1959.

Moment equations are obtained from the Boltzmann equation for a conducting gas in electric and magnetic fields. The moment equations consist of the conservation equations of mass, momentum, and energy with arbitrary stress and heat flux; and the constitutive equations of stress and heat flux. By assuming the Grad distribution function and slight ionization, it is possible to obtain relatively simple stress and heat flux equations yielding single-fluid description of the gas mixture. The associated boundary conditions are obtained by taking the assumed distribution function and applying conservation laws near the wall. These moment equations and boundary conditions together with Maxwell's

electromagnetic equations and their boundary conditions form a determinate system to describe the dynamics of a rarefied conducting gas in electric and magnetic fields. This system includes, as limiting cases, both the Grad 13-moment equations for rarefied gases and the usual continuum magneto-gas dynamic equations. (Contractor's abstract)

2485

Southern California U. Engineering Center, Los Angeles.

LOW-SPEED PLANE COUETTE FLOW OF A RAREFIED CONDUCTING GAS IN A UNIFORM TRANSVERSE MAGNETIC FIELD, by H.-T. Yang. Aug. 1960, 24p. incl. diagrs. (USCEC rept. no. 56-218) (AFOSR-TN-60-1002) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)95, and Office of Naval Research) AD 244123 Unclassified

The newly developed moment equations and boundary conditions for magnetogasdynamics (see item no. 2484, Vol. IV) are applied to low-speed plane Couette flow of a rarefied conducting gas in a uniform transverse magnetic field. The purpose is to demonstrate the feasibility of the new system and to gain understanding of the effect of rarefaction on magnetogasdynamics of Couette flow. The upper plate velocity is assumed to be small compared with the ambient speed of sound, and the temperature difference between the 2 plates is small compared with the ambient temperature. Consequently, the tangential flow quantities, like velocity, shear stress, and tangential heat flux can be solved separately from the normal quantities like pressure, temperature, normal stresses, and normal heat flux. The tangential quantities are greatly influenced by the transverse magnetic field, while there is little or no effect of the magnetic field on the normal quantities. The explicit expressions for tangential as well as normal quantities are obtained. As expected these results include those obtained for low-speed plane Couette flow in rarefied gasdynamics and in continuum magnetogasdynamics as limiting cases. The effect of the transverse magnetic field is to retard the flow; and the more rarefied the gas is, the more pronounced is the effect. As a result, the velocity slip is decreased due to the magnetic field. There is a heat flux in the flow direction despite absence of temperature gradient which is known as the Ettingshausen effect. The skin friction at the lower plate is decreased due to the magnetic-field, but the total drag of skin friction plus magnetic drag is increased. It is also found that both the induced electric current and the induced magnetic field decrease due to rarefaction. (Contractor's abstract)

2486

Southern California U. Engineering Center, Los Angeles.

K-BAND MICROWAVE INTERFEROMETER DESCRIPTION AND INITIAL EXPERIMENTS IN A PILOT-MODEL OF THE U.S.C. LOW-DENSITY WIND TUNNEL, by H. R. Pass. Aug. 1960, 62p. incl. illus. diagrs. tables, refs. (USCEC rept. no. 56-217) (AFOSR-TN-60-1087) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)95 and Office of Naval Research) AD 244125 Unclassified

A K-band microwave interferometer was assembled and was used to measure the phase shift through both nitrogen and argon afterglows of a continuous rf discharge in a model of the USC low-density wind tunnel. The interferometer is completely described and the results of proof or checkout tests are included; the model wind tunnel and the rf discharge apparatus are briefly described. This is followed by a presentation of the experimental procedure and by the results of some initial tests. The calculation procedure for reducing the phase shift to electron density, including assumptions and justifications, is then outlined. Order-of-magnitude estimates of the percentages of ionization and of the recombination coefficient are given and, finally, with the presentation of some emission spectrograph measurements, the processes involved in the afterglow are very briefly examined. (Contractor's abstract)

2487

Southern California U. Engineering Center, Los Angeles.

RESEARCH ON RAREFIED GASDYNAMICS, by R. L. Chuan. Nov. 1960, 115p. incl. illus. tables. (USCEC rept. no. 56-101) (AFOSR-22) (AF 18(603)95) AD 250253 Unclassified

A low density wind tunnel using a 2-phase cycle was developed, as well as a number of associated pressure and density instrumentation devices. Results of theoretical efforts in solutions of the Boltzmann equation along with development of associated boundary conditions, and investigations in magnetohydrodynamics (with special emphasis on the motion of artificial satellites) are summarized. (Contractor's abstract)

2488

Southern California U. Engineering Center, Los Angeles.

A METHOD OF SOLVING THE BOLTZMANN EQUATION OF GASES IN THE PRESENCE OF MEDIUM-RANGE FORCES AND ITS APPLICATIONS TO PLASMA OSCILLATIONS (Abstract), by T. Koga. [1959] [1]p. [AF 18(603)95] Unclassified

Presented at meeting of the Amer. Phys. Soc., Monterey, Calif., Dec. 3-5, 1959.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 320, Apr. 25, 1960.

A method of approach to treating the Boltzmann equation of gases in the presence of long- or medium-range forces is proposed. Force F is divided into 2 parts,

F^0 and F', where F^0 is simple and F' is rather complicated. Assuming that the number density of particles of velocity c^0 and of position r^0 in the presence of F^0 is known and is given by $f(c^0,r^0,t)$, the number density of particles of velocity c and of position r in the presence of force $F^0 + F'$ is shown to be given by $f(c-c', r-r',t)$. Here c' and r' are effects of F' on the variables, velocity and position, which specify a trajectory line. As an example of the theory, Dawson's theory of plane oscillations of electrons in a cold plasma is extended to be applied to plane oscillations in a hot plasma.

2489

Southern California U. [Engineering Center] Los Angeles.

MEASUREMENT OF ELECTRON DENSITY IN RAREFIED GAS STREAMS BY MICROWAVE INTERFEROMETRY (Abstract), by F. O. Smetana and H. R. Pass. [1960] [1]p. [AF 18(603)95] Unclassified

Presented at meeting of the Amer. Phys. Soc., Johns Hopkins U., Baltimore, Md., Nov. 21-23, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 213, Mar. 20, 1961.

A K-band microwave interferometer was constructed for the purpose of examining the efflux from a relatively small, hypersonic, low density nozzle, the efflux having been excited to an active condition in the nozzle by a high-power VHF discharge. The phase shifts obtained were interpreted as electron density according to the usual weak signal theory. Uniform distribution was assumed. Both nitrogen and argon were used as test gases. Because the VHF energy added per particle is highest, the recombination times the largest, and the attenuation of the microwave beam the least, highest phase shifts can be expected at relatively low pressures. This was found to be the case. Unfortunately, however, at these pressures the nozzle flow became subsonic because of very high viscous losses. At higher pressures where hypersonic flow was established, data were not obtained because of severe attenuation of the beam. At the test conditions electron densities in argon were about 100 times those in nitrogen, approaching 2×10^{12}/cc for neutral particle densities of about 3×10^{15}/cc. The effect of dielectric bodies in the stream also was investigated qualitatively. Application of this system to the measurement of electron density in the region of bodies in hypersonic flow is planned.

2490

Southern California U. Engineering Center, Los Angeles.

THE STRUCTURE OF STRONG SHOCK WAVES OF STABLE MONATOMIC MOLECULES, by T. Koga. Oct. 1960 [67]p. incl. diagrs. tables, refs. (USCEC rept. no. 83-201) (AFOSR-TN-60-1344) (AF 49(638)831) AD 247335; PB 153428 Unclassified

Also published in Rarefied Gas Dynamics; Proc. Second Internat'l. Symposium, California U., Berkeley [Aug. 3-6, 1960], New York, Academic Press, 1961, p. 481-499.

The present theory of plane shock waves of a monatomic gas is based on the following 3 hypothetical assumptions: (1) the distribution function $f(c_x, c_y, c_z)$ is separable and $f = f_x(c_x)f_{yz}(c_y, c_z)$, where the main flow is in the x-direction; (2) the characteristics of f_x are evaluated by the degree of unsymmetry; and (3) for the collision term of the Boltzmann equation, an approximation is taken similar to what was proposed by Bhatnagar and others. It is proposed that the persistence of state of a particle after its collision is to be taken into account. According to (1) and (2), two series of distribution functions are designed. There is no serious mathematical difficulty in solving 5 equations of moments by which the 5 unknown variables involved in an assumed distribution function are determined. The results are compared with those of other authors. According to the results, (1) and (2) seem plausible as long as the theory is contindd in a limited domain of interest so that moments of higher orders with respect to c_y and c_z are not involved in the theory. (Contractor's abstract)

2491

Southern California U. Engineering Center, Los Angeles.

INTERACTION BETWEEN A PLASMA AND A MICROWAVE, by T. Koga. Nov. 1960, 37p. incl. illus. table, refs. (USCEC rept. no. 83-202) (AFOSR-3) (AF 49(638)-831) AD 250254 Unclassified

A method of investigating the interaction between a plasma and a microwave is proposed. The electric field caused by electrons, the ionization, and recombination are taken into account. The displacement amplitude of electron oscillations is assumed to be small as compared with the wavelength. The number, the current, and the energy densities, as functions of time, are obtained together with the damping rate and phase-shift of the microwave. The results are almost exact solutions of the assumed basic equations. In a limiting case, the results agree with those of Margenau. This method will be valid also in cases where magnetic fields are taken into account. (Contractor's abstract)

2492

Southern California U. Engineering Center, Los Angeles.

A METHOD OF ANALYZING THE BOLTZMANN EQUATION OF ELECTRONS AND ITS APPLICATION TO

PLANE OSCILLATIONS OF ELECTRONS IN A WARM PLASMA, by T. Koga. Dec. 1960, 20p. incl. diagr. table. (USCEC rept. no. 83-203) (AFOSR-74) (AF 49-(638)831) AD 251076; PB 154710 Unclassified

Considering that the mass of an electron is much smaller than that of a heavy particle (ion or molecule), and that the number density of electrons is much smaller than that of heavy particles, the collision term of the Boltzmann equation for electrons is simplified. A method of analyzing the equation is devised by considering the subsidiary equations of the original equation. As an example, a plane oscillation of electrons in a warm plasma is studied. (Contractor's abstract)

2493

Southern California U. Engineering Center, Los Angeles.

CONDUCTIVITY OF PLASMAS TO HIGH-FREQUENCY ELECTRIC FIELDS (Abstract), by T. Koga. [1960] [1]p. [AF 49(638)831] Unclassified

Presented at meeting of the Amer. Phys. Soc., Gatlinburg, Tenn., Nov. 2-5. 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 198, Mar. 20, 1961.

By assuming a mode of distribution, Margenau solved the Boltzmann equation for electrons, under the assumptions that (a) the collision frequency of electrons is low as compared with the frequency of electric field ω, and (b) the amplitude of electric field E_0 is small. The first approximation of current is linear with respect to E_0. But higher approximations seem to involve terms of higher powers of E_0. In the present paper, the same Boltzmann equation is solved under assumption (a), regardless of (b). The scheme of solving the equation is similar to what was presented by the author at the 1959 meeting of Division of Plasma Physics. Current j expanded in a power series of (collision frequency)/ω is obtained. The first approximation is the same as that of Margenau. However, the relation between E_0 and j is linear, regardless of the order of approximation, and is different from the result of Margenthau's theory. The reason of the discrepancy will be given.

2494

Stanford Research Inst., Menlo Park, Calif.

MASS SPECTROMETRIC STUDY OF THE HEATS OF DIMERIZATION OF THE ALKALI CHLORIDES, by T. A. Milne and H. M. Klein. June 1960, 32p. incl. diagrs. tables, refs. (Technical note no. 6) (AFOSR-TN-60-512) (AF 49(638)89) AD 239918; PB 149159 Unclassified

Also published in Jour. Chem. Phys., v. 33: 1628-1637, Dec. 1960.

The heats of sublimation of the important species in equilibrium with the five alkali chlorides have been determined using the Bendix time-of-flight mass spectrometer. The mass spectrometrically determined differences between the heats of sublimation of monomer and dimer have been combined with the best available value for the monomer heat of sublimation to calculate the dimerization energies for all five salts. For LiCl a trimerization energy was also determined. These results are compared with the results of previous studies. (Contractor's abstract)

2495

Stanford Research Inst., Menlo Park, Calif.

ENERGIES OF THE GASEOUS ALKALINE EARTH HALIDES, by D. Cubicciotti. Nov. 1960, 6p. incl. tables, refs. (Technical note no. 7) (AFOSR-TN-60-1362) (AF 49(638)89) AD 247244 Unclassified

Also published in Jour. Phys. Chem., v. 65: 1058-1059, June 1961.

Binding energies are calculated for the gaseous halides of Be, Mg, Ca, Sr, and Ba for the dissociation reaction $MX_2(g)$ into $M^{++}(g)$ and $2X^-(g)$. The values are calculated according to the method of Rittner (Jour. Chem. Phys., v. 19: 1030, 1951); the dipole-dipole energy and the van der Waals dispersion energy are ignored because of their small contribution to the total energy. The agreement between the experimental and calculated values is poor; generally the deviation is much in excess of the 1% error of measurement of the internuclear distance and the + or - 10 to 20 kcal/mol which is the probable range of accuracy of the experimental heats. Binding energies are also calculated for the halides of Li, Na, K, Rb, and Cs in their dissociation according to the reaction MX(g) yields $M^+(g)$ and $X^-(g)$.

2496

Stanford Research Inst., Menlo Park, Calif.

THE ENERGY OF POLYMERIZATION OF THE GASEOUS ALKALI HALIDES, by D. Cubicciotti and T. A. Milne. Final technical rept. Dec. 1960, 61p. incl. diagrs. tables, refs. (AFOSR-TR-60-183) (AF 49(638)89) AD 249874; PB 154299 Unclassified

An investigation was made of the energy relationships among the important molecular forms in the gas and the condensed phases of the alkali halides. In particular, the energy of formation of polymers (such as dimers, Na_2Cl_2 trimers, Na_3Cl_3, etc.) from their monomers (i.e., NaCl)

has been investigated. The binding energy of the polymeric molecules relative to the monomeric form has been determined for the alkali halides both experimentally and theoretically and some insight into the nature of their interatomic forces has been gained.

2497

Stanford Research Inst., Menlo Park, Calif.

THE INTERACTION OF SLOW ELECTRONS WITH INSULATING CRYSTALS. I. THE ABSORPTION COEFFICIENT FOR PURE AND IRRADIATED MgO, by C. J. Cook and W. J. Fredericks. Mar. 31, 1960, 18p. incl. illus. diagrs. refs. (AFOSR-TN-60-269) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)353 and Army Engineer Research and Development Labs.) AD 234921 Unclassified

Also published in Jour. Chem. Phys., v. 36: 608-611, Feb. 1, 1962. (Title varies)

An attempt was made to determine the absorption coefficient, δ_a, for electrons incident on MgO and irradiated MgO when the impacting energy ranges from 0.2 ev through the conduction band (about 7.3 ev). It was found that electron trapping was so severe that the crystals would not thermally discharge at temperatures below 350°C. Consequently, the charged crystals were neutralized by a less satisfactory technique, high energy electron bombardment. δ_a was reproducible only at energies less than 4 ev. Inflection points were observed at about 1.80 ev and 3.00 ev. These lines correspond to luminescence spectra obtained for catalytic recombination of N on MgO. Since slow electrons are observed to interact predominantly with crystal defects, the data support suggestions that defects can play a dominant role in catalytic reactions. (Contractor's abstract)

2498

Stanford Research Inst., Menlo Park, Calif.

SHOCK WAVE COMPRESSION OF HARDENED AND ANNEALED 2024 ALUMINUM (Abstract), by G. R. Fowles. [1960] [1]p. [AF 49(638)353] Unclassified

Presented at meeting of the Amer. Phys. Soc., California U., Berkeley, Dec. 29-31, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 510, Dec. 29, 1960.

Application of elastic-plastic theory to plane shock waves in metals predicts that the stress normal to the front is larger than the hydrostatic pressure necessary to produce the same compression by an amount equal to two-thirds the yield strength in simple tension. Experiments designed to observe such differences (~ 1.2 kb) in the Hugoniot equation of state for hardened and annealed 2024 aluminum are described. Oblique shock geometry was employed. Shock and free-surface velocities were recorded with a smear camera by an optical lever technique. This technique provides continuous recording of free surface velocities with time, an essential requirement because of the existence of a double wave system. Observed elastic wave amplitudes (5.4 and ~1.0 kb) agree within experimental precision with predicted values. The shock wave data (20 to 50 kb) yields 1-dimensional strain isotherms which agree within experimental precision with semitheoretical curves based on Bridgman's hydrostatic data to 30 kb and simple tension stress-strain data. (No significant strain rate effects are observed.) It is concluded that elastic-plastic theory is valid for the description of plane shock waves in this material.

2499

Stanford Research Inst., Menlo Park, Calif.

EXCITATION OF LUMINESCENCE OF A SOLID BY NITROGEN ATOMS (Abstract), by K. M. Sancier, W. J. Fredericks, and H. Wise. [1960] [1]p. [AF 49(638)353] Unclassified

Presented at meeting of the Amer. Phys. Soc., California U., Berkeley, Dec. 29-31, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 511, Dec. 29, 1960.

A solid lumophor such as CaO or MgO may be made to luminesce when nitrogen atoms recombine heterogeneously at its surface. The recombination energy of the atoms transferred to the electronic and vibrational states of the solid is dissipated as luminescence and as heat. In order elucidate the mechanism of the energy transfer and conversion the quantitative relationship between these energies was studied. The luminescent energy was measured by ferrioxalate actinometry, the heat developed in the lumophor by calorimetry, and nitrogen atom concentration by NO titration. The recombination coefficient of nitrogen atoms on a CaO lumophor also was determined. Calculations indicate that for each nitrogen atom which recombines to produce luminescence, from 100 to 1000 atoms (depending upon lumophor) recombine to produce heat. The fact that this ratio changes with time of exposure to atoms raises the possibility that light and heat may be produced by different catalytic mechanisms.

2500

Stanford Research Inst., Menlo Park, Calif.

INTERNATIONAL SYMPOSIUM ON HIGH TEMPERATURE TECHNOLOGY, Asilomar, Calif. (Oct. 6-9, 1959), New York, McGraw-Hill, 1960, 511p. incl. illus. diagrs. tables, refs. (AFOSR-TR-60-29) (Sponsored jointly by Air Force Office of Scientific Research, Army Research

Office, Atomic Energy Commission, National Aeronautics and Space Administration, National Science Foundation, and Office of Naval Research under [ISSA-680-59-12])
Unclassified

This symposium was organized in order to present knowledge in the field of high velocity, high temperature gas flows to many disciplines other than high temperature chemical kinetics and high temperature plasmas (e.g., chemistry, ceramics, aerodynamics, etc.) so that there could be an interchange of ideas and integration of new knowledge. Twenty-two of the papers presented are published in this proceedings. These include several which report the state-of-the-art in a number of foreign countries. One paper (see item no. 1824, Vol. III) reports research done under an AFOSR contract.

2501

Stanford Research Inst. Poulter Labs., Menlo Park, Calif.

THE STUDY OF THE ORIGIN AND PROPAGATION OF DISTURBANCES IN THE BURNING OF SOLID PROPELLANTS, by G. A. Agoston. Summary rept. Feb. 1, 1959-Feb. 1, 1960. Feb. 17, 1960, 24p. incl. illus. diagrs. refs. (AFOSR-TN-60-336) (AF 49(638)565)
AD 236644; PB 147312 Unclassified

The behavior of shock waves was studied in the region of steep temperature gradients close to a burning solid propellant surface. The objective is to reveal underlying mechanisms which play significant roles in solid propellant combustion instability. Attempts were made to observe photographically the behavior of a shock wave near a burning solid propellant surface, near a burning monopropellant (liquid ethyl nitrate) surface and in the region of a flat ethylene-air flame. The photographs of solid propellants are not revealing. Much more readily interpretable pictures were obtained with the ethyl nitrate and the ethylene-air flames. The Schlieren photographs obtained of shock waves introduced in a direction parallel to the surface illustrate the distortion and stretching of the shock wave which occurs. Further tests are recommended. (Contractor's abstract)

2502

Stanford Research Inst. Poulter Labs., Menlo Park, Calif.

SOME PROPERTIES AND APPLICATIONS OF SHOCK WAVES, by G. E. Duvall. Oct. 17, 1960, 46p. incl. diagrs. tables, refs. (AFOSR-TN-60-1185) (AF 49-(638)625) AD 250114; PB 154350 Unclassified

Also published in Response of Metals to High Velocity Deformation; Proc. of a Technical Conf., Estes Park, Colo. (July 11-12, 1960), New York, Interscience Publishers, v. 9: 165-203, 1961.

Detonations and the shock waves they produce in inert materials are described qualitatively. Equations of the shock transition are given and applied in an example to obtain the amplitudes of shocks produced in several solids. Methods for measuring the equations of state of solids with shock waves are described and the reflection of a shock wave at a free surface is discussed. It is shown how phase transitions in materials give rise to multiple shock waves and how these in turn can be used to study transitions. There are unexplained discrepancies between static and shock-induced phase transitions, and the explanation of these may shed new light on the mechanisms of transition. Plastic yield is shown to also produce multiple shocks in solids, one of which is an elastic wave. Measurements of this forerunning elastic wave have been reported by several investigators, and these are presented as dynamic yield strengths, which are compared to static values. Results indicate the plastic yield mechanisms to be similar in static and shock phenomena. The shock following the elastic wave is discussed in terms of dislocation theory, and the Hugoniot from an elastic-plastic model is compared with that from a hydrodynamic model. (Contractor's abstract)

2503

Stanford Research Inst. Poulter Labs., Menlo Park, Calif.

SHOCK WAVE COMPRESSION OF HARDENED AND ANNEALED 2024 ALUMINUM, by G. R. Fowles. [1960] [13]p. incl. illus. diagrs. table, refs. (AFOSR-117) (AF 49(638)625) AD 249875 Unclassified

Also published in Jour. Appl. Phys., v. 32: 1475-1487, Aug. 1961.

Measurements of the Hugoniot equations of state of hardened and annealed 2024 aluminum at pressures below 50 kbar are presented. The major aim of the experiments was to determine the validity of elastic-plastic theory, which predicts that, at a given compression, the stress normal to the shock front is larger than the hydrostatic pressure necessary to produce the same compression by an amount equal to two-thirds the yield strength in simple tension. Oblique shock geometry was employed. Shock and free-surface velocities were recorded with a streak camera by means of a light-reflection technique employing the principle of the optical level. This technique provides continuous recording of free-surface motion with time, an essential requirement because of the existence of a double shock system. The observed elastic wave amplitudes (5.4 ± 0.2 kbar and 0.9 ± 0.2 kbar for hardened and annealed material, respectively) agree within experimental precision with values predicted from static tensile specimen data. The shock wave data, in the range 25-50 kbar, yield 1-dimensional strain isotherms which, while significantly different for the 2 different hardness conditions, agree within experimental precision with semitheoretical curves based on Bridgman's hydrostatic data to 30 kbar and on simple tension stress-strain data. No significant strain rate effects are evident. It is concluded that elastic-plastic theory is valid for the description of plane shock waves in this material. (Contractor's abstract)

2504

Stanford Research Inst. Poulter Labs., Menlo Park, Calif.

SHOCK-WAVE COMPRESSION OF ALUMINUM, by D. G. Doran, G. R. Fowles, and G. A. Peterson. [1958] [3]p. incl. diagrs. (AFOSR-3634) [AF 49(638)625] Unclassified

Also published in Phys. Rev. Ltrs., v. 1: 402-404, Dec. 1, 1958.

Use of a new reflected-light technique with oblique shock waves allows dynamic pressure-compression measurements to be made in the region between existing dynamic measurements (50 to 500 kb) and the elastic regime. Previous methods using argon gaps were restricted to pressures above about 50 kb in order to produce flashing of the argon. The feasibility of the method has been demonstrated for aluminum. Shock and free-surface velocity measurements were made along the center line of the face of a wedge-shaped specimen backed by a line-initiated slab of high explosive. Advantages to the reflected-light technique over argon gaps are (1) improved time resolution due to the sharpness of the trace, (2) elimination of the necessity of making shock and free-surface measurements at different points on the specimen face and, therefore, of consequent uncertainties due to curvature of the shock, and (3) reduction in minimum specimen size.

2505

Stanford U. Applied Mathematics and Statistics Lab., Calif.

UNIFORM BOUNDEDNESS FOR GROUPS, by I. Glicksberg. Dec. 1959, 16p. (Technical note no. 11) (AFOSR-TN-60-33) (AF 49(638)294) AD 232392; PB 145790 Unclassified

Analogues of the uniform boundedness results for Banach spaces are established for locally compact Abelian groups. The following theorems are (1) If K is a subset of G which is (conditionally) compact in the topology of pointwise convergence on G*, then K is (conditionally) compact in G. (2) Let Hom(G,H) be the space of all continuous homomorphisms from G into H, in the compact-open topology, and let $T \subset \mathrm{Hom}(G,H)$. Then T is conditionally compact if $Tg = \{\tau g : \tau \in T\}$ and $T^*h^* = \{\tau^* h^* : \tau \in T\}$. (3) Let τ be a continuous homomorphism of G onto H. Then τ is open if $\bar{\tau}$ F is locally Borel for each closed F in G/G_τ.

2506

Stanford U. Applied Mathematics and Statistics Lab., Calif.

ALMOST PERIODIC FUNCTIONS ON SEMIGROUPS, by K. deLeeuw and I. Glicksberg. May 31, 1960, 81p. incl. refs. (Technical note no. 12) (AFOSR-TN-60-488) (AF 49(638)294) AD 238540; PB 148740 Unclassified

Also published in Acta Math., v. 105: 99-140, 1961.

The fundamental approximation theorem for almost periodic functions on groups is extended to certain commutative topological semigroups. It is said that the approximation theorem holds for S if linear combinations of semicharacters of S are dense in A(S); i.e., if each function in A(S) can be approximated uniformly on S by linear combinations of semicharacters of S. The theorem does not generally hold for commutative semigroups and may fail for a subsemigroup of a discrete group. The theorem is established for: (1) cones in finite dimensional Euclidean spaces in the usual topology, (2) finitely generated subsemigroups of commutative groups in the discrete topology, and (3) semigroups consisting of the non-negative elements of a totally ordered commutative group in any "reasonable" topology. It is also shown that the class of commutative topological semigroups for which the approximation theorem holds is closed under the formation of products.

2507

Stanford U. Applied Mathematics and Statistics Lab., Calif.

BANACH ALGEBRAS WITH SCATTERED STRUCTURE SPACES, by I. Glicksberg. Aug. 11, 1960, 15p. incl. refs. (Technical note no. 13) (AFOSR-TN-60-805) (AF 49(638)294) AD 241395; PB 150107 Unclassified

Also published in Trans. Amer. Math. Soc., v. 98: 518-526, 1961.

A commutative semisimple Banach algebra B is considered where M_B denotes its space of non-zero multiplicative linear functionals, and $x \to \hat{x}$ its Gelfand representation. An application is given of a theorem of Silov which shows that for any compact-open subset U of M_B, there is an x in B with $\hat{x}$ the characteristic function φ_U of U. The main result is from A, a Banach algebra which forms, algebraically, a subalgebra of a commutative semisimple Banach algebra B. If the functionals in ∂_U are included in the restrictions to A of the elements of ∂_B, one says ∂_A arises from, or is produced by ∂_B. As is well known this occurs if A is a closed subalgebra of B, and as a consequence, boundary $\sigma_{A_a}(a) \subset \hat{a}(\partial_{A_a})$. Indeed, $\sigma_{A_a}(a)$ can be identified with M_{A_a} in such a way that boundary $\sigma_{A_a}(a)$ is precisely ∂_{A_a} (which arises from ∂_A.

2508

Stanford U. Applied Mathematics and Statistics Lab., Calif.

EXPONENTIAL POLYNOMIALS ON COMMUTATIVE SEMIGROUPS, by J. J. Stone. Nov. 25, 1960, 72p. incl. refs. (Technical note no. 14) (AFOSR-TN-60-1097) (AF 49(638)294) AD 243780; PB 153860 Unclassified

S is taken to be a commutative topological semigroup with identity. The translation operators T_a for a in S are defined on functions f on S by $[T_a f](x) = f(x + a)$. It is shown that if S is a group, a necessary and sufficient condition for a continuous function f to have its translates span a finite-dimensional space for f to be in the algebra generated by continuous functions satisfying $\psi(x + y) = \psi(x) + \psi(y)$, x, y$\epsilon$ S or $\chi(x + y) = \chi(x)\chi(y)$, x, y$\epsilon$ S. Some results are established concerning commutative topological semigroups. A continuous function f on a topological semigroup S is called uniformly algebraic if there exists a polynomial P such that $P(T_a) f = 0$ for all a. Consideration of the functions f_{ba} defined on integers by $f_{ba}(n) = f(b + na)$ yields a characterization of the uniformly algebraic functions. A special class of uniformly algebraic functions turns out to be the class of functions f, sometimes called polynomials, such that $\{ f_{ba} \mid b \epsilon S, a \epsilon S \}$ are polynomials in n of uniformly bounded degree. These functions are discussed in some detail. In general they constitute a wider class of functions than the algebra generated by additive functions and constants, a more restrictive notion of polynomial. A necessary and sufficient condition on locally compact groups for these classes of polynomials to be equal is given. Finally a few applications of the theory are described. (Contractor's abstract)

2509

Stanford U. Applied Mathematics and Statistics Lab., Calif.

CONTINUOUS TIME STOCHASTIC STORAGE PROCESSES WITH RANDOM LINEAR INPUTS AND OUTPUTS, by R. G. Miller, Jr. Sept. 23, 1960, 35p. (Technical rept. no. 61) (AFOSR-3158) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22552) AD 243978 Unclassified

Also published in Jour. Math. and Mech., v. 12: 275-291, Mar. 1963.

The behavior of a storage process is determined by the input process and the output mechanism. Models were proposed to analyze a system in discrete or continuous time by imposing varied assumptions on the input and output. The following model is discussed: Let X(t) be the level of the storage process at time t; X(0) = 0. Starting at time 0 the level X(t) increases linearly for a random length of time after which it decreases linearly for a random time. The process continues to alternate between periods of increase and decrease. All time intervals are independently distributed, and the periods of increase and decrease are identically distributed, respectively. Should X(t) return to 0 at some time t > 0 it remains at this level until the end of the current period of decrease. The fluctuations between increase and decrease can be interpreted in 3 ways: (1) periods of input and output actually alternate and never overlap, (2) there is always a constant linear output to the system provided the level is greater than zero but the input process shuts on and off, and (3) the constancy of input and output is reversed, i.e., constant input but alternating output.

2510

Stanford U. Applied Mathematics and Statistics Lab., Calif.

SEQUENTIAL TESTS FOR THE MEAN OF A NORMAL DISTRIBUTION, by H. Chernoff. Aug. 26, 1960, 26p. (Technical rept. no. 59) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22552) AD 242991 Unclassified

Also published in Proc. Fourth Berkeley Symposium on Mathematical Statistics and Probability, California U., Berkeley (June 20-July 30, 1960), Los Angeles, California U. Press, 1961, v. 1: 79-91. (AFOSR-2135)

The problem of sequentially testing whether the drift of a Wiener process is positive or negative, given an a priori normal distribution, is reduced to the solution of a free boundary problem involving a diffusion equation. (Contractor's abstract)

2511

Stanford U. Applied Mathematics and Statistics Lab., Calif.

MULTIVARIATE CORRELATION MODELS WITH MIXED DISCRETE AND CONTINUOUS VARIABLES, by I. Olkin and R. F. Tate. Aug. 28, 1960, 35p. incl. illus. (Technical rept. no. 58) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22552) AD 242990 Unclassified

A multivariate extension is considered in which $x = (x_0, x_1, \cdots, x_k)$ has a multinomial distribution, and the conditional distribution of $y = (y_1, \cdots, y_p)$ for fixed x is multivariate normal. (Contractor's abstract)

2512

Stanford U. Applied Mathematics and Statistics Lab., Calif.

ESTIMATING THE INFINITESIMAL GENERATOR OF A CONTINUOUS TIME, FINITE STATE MARKOV PROCESS, by A. Albert. Aug. 31, 1960, 1v. (Technical rept. no. 60) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22552) AD 242992
Unclassified

Let $\{ Z(t), t > 0 \}$, be a separable, continuous time Markov process with stationary transition probabilities $P_{ij}(t)$, i, j = 1, 2, ..., M. Under suitable regularity conditions, the matrix of transition probabilities, P(t), can be expressed in the form $P(t) = \exp tQ$, where Q is an M x M matrix and is called the infinitesimal generator for the process. A density on the space of sample functions over [0, t] is constructed. This density depends upon Q. If Q is unknown, the max likelihood estimate $Q'(k, t) = \|q'_{ij}(k, t)\|$, based upon k independent realizations of the process over [0, t], can be derived. If each state has positive probability of being occupied during [0, t] and if the number of independent observations, k, grows large (t held fixed), then q'_{ij} is strongly consistent, and the joint distribution of the set $\{\sqrt{k}\,(q'_{ij} - q_{ij})\}_{i \neq j}$ (suitably normalized) is asymptotically normal with zero mean and covariance equal to the identity matrix. If k is held fixed and if t grows large, then q'_{ij} is again strongly consistent, and the joint distribution of the set $\{\sqrt{t}\,(q'_{ij} - q_{ij})\}_{i \neq j}$ (suitably normalized) is asymptotically normal with zero mean and covariance equal to the identity matrix, provided that the process $\{ Z(t), t > 0 \}$ is positively regular. The asymptotic variances of the q'_{ij} are computed in both cases. (Contractor's abstract)

2513

Stanford U. Biophysics Lab., Calif.

PRECISION g-VALUE MEASUREMENTS ON FREE RADICALS OF BIOLOGICAL INTEREST, by M. S. Blois [Jr.], H. W. Brown, and J. E. Maling. Aug. 1960, 21p. incl. diagrs. tables, refs. (BL rept. no. 11) (AFOSR-TN-60-716) (AF 18(600)1511) AD 246139
Unclassified

Also published in Proc. Symposium on Free Radicals in Biological Systems, Stanford U., Calif. (Mar. 21-23, 1960), New York, Academic Press, 1961, p. 117-131.

The absolute g-values for all the unsubstituted aromatic hydrocarbon ions studied lie within 2 parts in 10^4 of the free spin g-value, $g_e = 2.00229$, and the shifts are positive. The hydrocarbon negative ions as a group are shifted about twice as much as the hydrocarbon positive ions, and there may be some systematic variation within the groups. For the negative ion series, naphthalene, anthracene, tetracene, and pentacene, g-value is a decreasing function of size; whereas for positive ions of the same series (naphthalene excluded), g-value may be an increasing function of size. In general, g-value is not a simple function of the number of rings but depends upon over-all molecular configuration as well. Coronene, with 6 rings, for example, is quite high. Replacing 2 ring protons of an aromatic hydrocarbon with 2 oxygens, forming the semiquinone, shifts g-values positively about 1 part in 10^3, or an order of magnitude greater than the shifts for the unsubstituted hydrocarbons. For the semiquinones, the g-value decreases about one part in 10^4 with each ring which is added. A single methyl substitution in the semiquinones gives a negative shift of about 1/4 that of a single added ring. Halogen substitution gives a large positive shift which is an increasing function of the atomic spin-orbit coupling parameter of the halogen substituent. Shifts due to changes in temperature, solvent, and radical concentration are small compared to shifts due to changes in molecular structure. (Contractor's abstract)

2514

Stanford U. [Biophysics Lab.] Calif.

THE COENZYME Q_{10} AND VITAMIN K_1 SEMIQUINONE FREE RADICALS, by M. S. Blois, Jr. and J. E. Maling. [1960] [4]p. incl. diagrs. (AFOSR-TN-60-849) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1511 and National Institutes of Health) AD 245569
Unclassified

Also published in Biochem. and Biophys. Research Commun., v. 3: 132-135, Aug. 1960.

Analysis is presented of e.s.r. spectrum of coenzyme Q_{10} semiquinone. The spectrum shows 9 evenly spaced components with a line separation of 1.1 gauss, and a g-value of 2.00467 ± .00002. The methylene protons are assumed to produce the line splitting of 1.1 gauss. The quartet produced by methyl protons will then have line separations of 2.2 gauss which is consistent with a previous value for the splitting of methyl protons attached to a single aromatic ring. From this, the line assignment for the semiquinone of vitamin K_1 can be made by adding the effect of the protons of the second ring. The line assignment chosen thus yields the observed number of lines, a line separation close to that expected (a splitting of 0.55 gauss for the effect of added ring protons) and a ratio of line intensities which agrees with the integrated spectrum. The line assignments corroborate the view that the odd electron is fairly well localized to the aromatic nucleus of these radicals and that it does not interact strongly with the aliphatic chain beyond the first methylene group.

2515

Stanford U. Biophysics Lab., Calif.

ELECTRON PARAMAGNETIC RESONANCE STUDIES OF BIOLOGICAL AND BIOCHEMICAL SYSTEMS, by M. S. Blois [Jr.]. Final rept. July 1, 1955-Aug. 31, 1960. Oct. 1960, 1v. incl. diagrs. tables, refs. (BL rept. no. 12) (AFOSR-TR-60-147) (AF 18(600)1511) AD 247438; PB 153411 Unclassified

An evaluation was made of electron paramagnetic resonance (epr) methods in biological research with emphasis on the study of biological free radicals. The non-enzymatic oxidation or reduction of a number of naturally occurring quinols or quinones, was undertaken. The oxidation of polyphenolic aromatic compounds, or the reduction of quinones, involved free radical intermediates which were formed by the compulsory univalent oxidation or reduction mechanism as predicted by Michaelis (The Enzymes, Chap. 44, Academic Press, 1951). These intermediates were observable by epr in vitro, in some cases revealing their structure by their hyperfine spectra, and in all cases were characterized by their g-value. The epr of natural melanin was studied. The melanin was prepared by the in vitro action of tyrosinase on a variety of substrates, and the polymer resulted from the non-enzymatic, auto-oxidation of these substrates. In all cases the purified polymer showed an epr signal characteristic of a free radical.

2516

Stanford U. Biophysics Lab., Calif.

ON THE OCCURRENCE OF FREE RADICALS IN AIR POLLUTANTS, by M. S. Blois [Jr.]. [1960] [2]p. (Sponsored jointly by [Air Force Office of Scientific Research under AF 18(600)1511] and National Institutes of Health) Unclassified

Presented at Third Conf. on Emphysema, Aspen, Colo., June 10, 1960.

Published in Amer. Rev. Respiratory Diseases, v. 83: 414-415, Mar. 1961.

The problem of determining if free radicals exist in the air and if they do, if they have appropriate lifetimes, reactivity, and concentrations is investigated. Preliminary experiments have been performed in which cigarette smoke was bubbled through a tall column of α,α-diphenyl-β-picryl hydrazyl (DPPH) in a standardized, cyclic pattern, and the resulting decoloration was taken as a measure of the free radical concentration in the smoke. The observations made were consistent with the view that perhaps 1/10 to 1/3 of the radicals detected were highly reactive alkyl and low molecular weight species, whereas the remainder were less reactive species and probably included the aromatic hydrocarbon radicals. Atmospheric pollutants collected on a glass fiber mat were also subjected to electron paramagnetic resonance (epr) and the results indicated that activity was present even after about 2 months. It seems certain that paramagnetic materials are indeed present in particulate atmospheric pollutants, and, from the results, it seems probable that at least a part of the activity is due to stabilized free radicals.

2517

Stanford U. Biophysics Lab., Calif.

THE PRECISE MEASUREMENT OF FREE RADICAL g-VALUES AND THEIR DEPENDENCE UPON STRUCTURE, by M. S. Blois, Jr., H. W. Brown, and J. E. Maling. [1960] [20]p. incl. diagrs. tables, refs. (Bound with its AFOSR-TR-60-147; AD 247438) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)1511 and National Institutes of Health) Unclassified

Presented at Ninth Colloque AMPERE, Pisa (Italy), Sept. 12-16, 1960.

Also published in Arch. Sci. (Genève), v. 13: 243-255, 1960.

The problem of precisely measuring g-values, the experimental methods used, and certain specific instances of the manner in which a free radical's g-value is affected by its structure are discussed. Measurements were made of the g-values of hydrocarbon ions, semiquinone free radicals, and the halogenated semiquinones. The 3 series of carbon radicals all have g-values only slightly greater than the free spin value, (b) the benzo-, naphtho-, anthraquinone and their methyl derivatives have a monotonic, probably linear dependence of g-value upon energy level shifts ($\Delta E_{n\rightarrow\pi}$) when the spin-orbit parameter is the same, and (c) the halogenated semiquinone series shows the effect of varying the spin-orbit parameter. The results were in good agreement with the qualitative theory of McConnell and Robertson (Jour. Phys. Chem., v. 61: 1018, 1957).

2518

Stanford U. Dept. of Aeronautical Engineering, Calif.

HEAT CONDUCTION AND THERMAL STRESSES IN A SOLID HAVING UNEQUAL SPECIFIC HEATS, by E. W. Parkes. Feb. 1960 [23]p. incl. diagrs. (SUDAER no. 90) (AFOSR-TN-60-320) (AF 49(638)223) AD 238410; PB 148506 Unclassified

In thermoelastic analyses, heat conduction and stressing problems are usually separated. This division can only be justified if the specific heat at zero stress for the material is closely equal to that at zero strain. For some materials in missile construction, the ratio of specific heats may depart from unity by 25%. This paper investigates the transient temperature distribution and thermal stresses in a solid subjected to 1-dimensional heat flow and various kinds of stress-inducing restraints,

when the specific heats are unequal. Allowance is made for the stress terms in the heat conduction equation (which are ignored when the analysis is divided) and for the variation of specific heat with temperature. It is concluded that the errors introduced by the conventional approach, although not entirely negligible, are not such as to justify the labor involved in the more correct analysis.

2519

Stanford U. Dept. of Aeronautical Engineering, Calif.

THE STRESSES IN AN ELASTIC-PLASTIC BAR SUBJECTED TO A SUDDEN CHANGE OF SURFACE TEMPERATURE, by E. W. Parkes. Jan. 1960, 20p. incl. diagrs. (SUDAER no. 89) (AFOSR-TN-60-321) (AF 49-(638)223) AD 238411; PB 148505 Unclassified

An analysis is given for the stress history in an elasto-plastic bar subjected to a sudden change of surface temperature. The type of behavior is found to depend on the ratio of thermal strain (αV) to yield strain (σ_y/E). For $E\alpha V/\sigma_y < 1$, the stresses are entirely elastic. For $1 < E\alpha V/\sigma_y < 2.04$ there are 2 transient zones of compressive yielding. For $2.04 < E\alpha V/\sigma_y < 4.4$ there are 2 transient zones of compressive yielding and 2 enduring zones of tensile yielding. For $E\alpha V/\sigma_y > 4.4$ there are 2 transient zones of compressive yielding, 1 transient zone of tensile yielding, and 2 enduring zones of tensile yielding. The investigation is restricted to the range $0 \leq E\alpha V/\sigma_y \leq 5$ and the particular case $E\alpha V/\sigma_y \to \infty$. Detailed solutions are given for $E\alpha V/\sigma_y = 1, 2, 3, 4, 5$ and ∞. (Contractor's abstract)

2520

Stanford U. Dept. of Aeronautical Engineering, Calif.

THERMOELASTICITY, by E. W. Parkes. Feb. 1960, 91p. incl. diagrs. table. (SUDAER no. 91) (AFOSR-TN-60-380) (AF 49(638)223) AD 238412; PB 148507 Unclassified

Certain aspects of the classical approach to thermal stress problems are presented. Some of the topics discussed in the condensed reproduction of a lecture course are: (1) thermal and elastic constants, (2) Maxwell's equations and the relations between the thermoelastic constants, (3) the thermoelastic equations, (4) boundary conditions, (5) the heat conduction equation, (6) elastic thermal stresses and their effects on stiffness, and (7) inelastic thermal stresses and a design philosophy for repeated thermal loading.

2521

Stanford U. Dept. of Aeronautical Engineering, Calif.

IDEALIZED COLUMNS, by N. J. Hoff. Aug. 1958, 23p. incl. diagrs. refs. (SUDAER no. 82) (AFOSR-TN-60-381) (AF 49(638)223) AD 238413; PB 148752 Unclassified

Since von Karman's experiments, it has been customary to use solid rectangular section columns in experimental and theoretical work in both the elastic and inelastic ranges. The highly non-linear creep laws render the analysis of a rectangular section column a difficult task while the treatment of an idealized I section is considerably simpler. The ideal I section consists of 2 flanges each of an area A/2 held a distance h apart by a web which cannot resist normal stresses but is perfectly rigid in shear. As columns used in structural engineering are generally much closer in their properties to ideal I, the ordinary elastic-plastic buckling problem is treated with the assumption that the cross section is an ideal I. Graphic methods and simple analytic formulas are presented for the determination of reduced-modulus buckling stress, tangent-modulus buckling stress, Shanley's buckling stress with corresponding strain, stress reversal in the elastic range, the Ramberberg-Osgood relationship, and creep buckling. The results are quite valid only for columns of idealized I section but they represent good approximations in the case of extruded and built up sections.

2522

Stanford U. Dept. of Aeronautical Engineering, Calif.

HIGH TEMPERATURE STRUCTURES, by N. J. Hoff. June 1958, 42p. incl. illus. diagrs. table, refs. (SUDAER no. 79) (AFOSR-TN-60-383) (AF 49(638)223) AD 238415; PB 148750 Unclassified

A survey is given of the problems confronting the airplane and missile structural designer and analyst in consequence of aerodynamic heating. The survey covers such problems as high temperature, thermal stresses and thermal buckling, shell theory, creep, and creep buckling. The need to expand the knowledge of the structures man into such fields as gas dynamics, thermodynamics and the physics of the solid state is pointed out. (Contractor's abstract)

2523

Stanford U. Dept. of Aeronautical Engineering, Calif.

A THEORY OF ELASTIC, PLASTIC AND CREEP DEFORMATIONS OF AN INITIALLY ISOTROPIC MATERIAL SHOWING ANISOTROPIC STRAIN-HARDENING, CREEP RECOVERY, AND SECONDARY CREEP, by J. F. Besseling. Apr. 1958 [36]p. incl. diagrs. refs. (SUDAER no. 78) (AFOSR-TN-60-384) (AF 49(638)223) AD 238416; PB 148749 Unclassified

Also published in Jour. Appl. Mech., v. 25: 529-536, Dec. 1958.

For abstract see item no. STA.13:002, Vol. II.

2524

Stanford U. Dept. of Aeronautical Engineering, Calif.

INFLUENCE COEFFICIENTS FOR RADIATION IN A CIRCULAR CYLINDER, by E. W. Parkes. Mar. 1960, 11p. incl. diagrs. tables. (SUDAER no. 92) (AFOSR-TN-60-415) (AF 49(638)223) AD 238417; PB 148508 Unclassified

Also published in Internat'l. Jour. Heat and Mass Transfer, v. 2: 155-162, Mar. 1961.

A table of influence coefficients is calculated from which the distribution of absorbed radiation in a long circular cylinder having any distribution of emitted radiation can readily be determined. Lambert's law of diffuse emission and reflection is assumed, and the coefficient of absorptivity is supposed constant. A table of functions for the distribution of reflected radiation after each reflection up to the tenth is also given, so that the results can be compared with non-Lambertian systems. (Contractor's abstract)

2525

Stanford U. Dept. of Aeronautical Engineering, Calif.

DAMPING OF THE VIBRATIONS OF A COILED SPRING DUE TO CREEP, by N. J. Hoff. June 1960 [32]p. incl. diagrs. tables. (SUDAER no. 96) (AFOSR-TN-60-833) (AF 49(638)223) AD 259374 Unclassified

Also published in Creep in Structures; Colloquium, Stanford U., Calif (July 11-15, 1960), New York, Academic Press, 1962, p. 355-373.

The vibrations of a concentrated mass suspended from a coiled spring are studied when the material of the spring is capable of deforming both elastically and in consequence of creep. When the creep law is linear, the attenuation of the vibrations is independent of the amplitude. When the creep law is non-linear in the sense that the creep rate is a power function of the force transmitted by the spring, with the exponent greater than unity, the attenuation increases with increasing amplitude.

2526

Stanford U. Dept. of Aeronautical Engineering, Calif.

CREEP EXPERIMENTS WITH STEPWISE CHANGES OF THE TENSILE LOAD (DATA ON 5052 Al. ALLOY AT 450°F), by J. F. Besseling and D. W. Dutton. Aug. 1960, 28p. incl. illus. diagrs. (SUDAER no. 95) (AFOSR-TN-60-1330) (AF 49(638)223) AD 259375 Unclassified

A description is given of equipment developed for creep tests carried out in a screw-type tensile testing machine with electrical drive. The load is held constant within 5 lb by a sensitive on-off control of the electrical drive of the testing machine, and stepwise load changes can be realized by an adjustable strain-gauge bridge. The on-off control of the oven, which is designed for temperatures up to 900°F, keeps the temperature of the gauge length of the specimen constant within 1°F. Temperature measurements are taken by means of thermocouples welded to the specimen. Strain measurements under stable temperature conditions are obtained with the aid of an extensometer equipped with differential transformers. Elongation and temperature of the specimen are recorded continuously or at regular intervals, with an accuracy of 1/10,000 in. and 1°F, respectively. The report includes creep data for stepwise load changes for Al alloy 5052 at 450°F.

2527

Stanford U. Dept. of Chemistry, Calif.

SPIN DISTRIBUTION IN NAPHTHALENE NEGATIVE ION, by T. R. Tuttle, Jr. July 1960 [1]p. (Technical note no. 2) (AFOSR-TN-60-260) (AF 49(638)482) AD 240957 Unclassified

Also published in Jour. Chem. Phys., v. 32: 1579, May 1960.

The ESR absorption spectrum of naphthalene negative ion with 53 at-% C^{13} in one β position has been observed in dilute 1,2-dimethoxyethane solution at room temperature. This spectrum is well represented by a superposition on the spectrum of ordinary naphthalene negative ion of a spectrum in which each line has been doubled with a splitting of 1.2 gauss. The data for C^{13} splittings in naphthalene negative ion combined with values of ρ_α and ρ_β calculated from proton hyperfine splittings yield $k_1 = 13.5$ gauss, $k_2 = -5.9$ gauss. These constants are in agreement with C^{13} splittings and π spin densities in triphenylmethyl-C^{13} and methyl^9-C^{13}. In the case of triphenylmethyl-C^{13} the best agreement is obtained if the 3 rings are considered coplanar. (Contractor's abstract)

2528

Stanford U. Dept. of Chemistry, Calif.

PROTON RESONANCE SHIFTS IN DIPHENYL PICRYL HYDRAZYL, by M. E. Anderson, G. E. Pake, and T. R. Tuttle, Jr. July 1960 [3]p. incl. diagrs. tables. (AFOSR-TN-60-862) (AF 49(638)482) AD 440596 Unclassified

Published in Jour. Chem. Phys., v. 33: 1581-1583, Nov. 1960.

For abstract see item no. 2535, Vol. IV.

2529

Stanford U. Dept. of Chemistry, Calif.

ELECTRON SPIN RESONANCE OF ORGANIC FREE RADICALS, by T. R. Tuttle, Jr. Final rept. Sept. 1, 1958-Sept. 31, 1960. Oct. 26, 1960, 3p. (AFOSR-TR-60-168) (AF 49(638)482) Unclassified

Proton hyperfine splittings have been studied in detail in several free radicals. In particular the toluene negative ion electron spin resonance spectrum has been almost complete analyzed along with the spectra of anions of ethyl benzene, cumene, and secondary butyl benzene. Carbon-13 studies were made in the anions of naphthalene, toluene, and m-xylene. The hyperfine splitting from a carbon-13 in the β-position of naphthalene was evaluated and used to develop an equation of value in determining unpaired electron distributions. Studies of proton resonance shifts in solid free radicals at 4.2°K and below included observation of 1,1-diphenyl-2-picrylhydrozyl, potassium pyrenide, and potassium salts of naphthalenide, biphenylide, perylenide, coronenide anthracenide, naphthacenide, and α- and β-methylnaphthalenide. Work on motions in solutions, and experiments with new free radicals are mentioned briefly.

2530

Stanford U. Dept. of Mechanical Engineering, Calif.

SIMPLE METHODS FOR CLASSIFICATION AND CONSTRUCTION OF SIMILARITY SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS, by D. E. Abbott and S. J. Kline. Oct. 1960, 48p. incl. refs. (Rept. no. MD-6) (AFOSR-TN-60-1163) (AF 49(638)201) AD 251813 Unclassified

Simple methods for establishing similarity solutions are given. The mathematical interpretation of the term similarity is a transformation of variables to achieve a reduction in the number of independent variables in the differential equations. Physically, the existence of a similarity usually implies the lack of a characteristic length in 1 or more coordinates of the problem. The approach used is to develop 2 methods for finding similarity variables based upon the mathematical technique of solving partial differential equations by separation-of-variables. The emphasis in both methods is on motivation. It is possible to classify physical problems into 2 mathematical catogories: problems which are mathematically well-posed and those which are not. The 2 methods presented emphasize the fact that if a similarity variable is not found for the particular class of transformations assumed, it cannot be concluded that none exist, but only that there is no similarity variable under that class of transformations. The 2 methods for finding similarity solutions are developed and compared in terms for 2 well-known problems; the suddenly accelerated flat plate, and the classical Blasius solution for laminar flow over a flat plate. Finally, 5 other examples are given to illustrate the types of problems which can be treated and some refinements of technique which are possible. (Contractor's abstract)

2531

Stanford U. Dept. of Medical Microbiology, Calif.

NEURAMINIC ACID AND CENTRAL NERVOUS SYSTEM FUNCTION, by W. Cutting, N. Eldredge, and G. Read. [1960] 17p. incl. diagrs. tables, refs. (AFOSR-TN-60-1430) (AF 49(638)714) AD 252438 Unclassified

Neuraminic acid is present in the central nervous system combined with lipids and proteins. Its function is unknown. It may participate in a blood-brain barrier antibody system which maintains the special internal environment of the brain. Disfunction of the brain might result from failure of this system under stress, as in anoxia. This study was initiated to evaluate neuraminic acid for physiological activity. The project was 2-fold: (1) the isolation of gram quantities of N-acetyl neuraminic acid (NANA), free and bound; and (2) testing for the effects of these compounds on a cat, rats, mice and goldfish. The variables tested were random motion, blood pressure, pulse pressure, heart rate, respiratory rate, respiratory amplitude, electroencephalogram, and skin resistance. There was no altered physiological activity when NANA (free and bound) was injected alone or in conjunction with γ-aminobutyric acid. NANA with lysergic acid diethylamide (LSD) showed no different effects than LSD alone. Results suggest that NANA should be depleted or inactivated in order to show NANA's role in brain metabolism. (Contractor's abstract)

2532

Stanford U. Dept. of Physics, Calif.

PARAMAGNETIC RELAXATION IN SOLUTIONS OF VO^{++}, by R. N. Rogers and G. E. Pake. Apr. 1960 [20]p. incl. diagrs. refs. (Technical note no. 4) (AFOSR-TN-60-429) (AF 18(603)131) AD 237243; PB 147741 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 253, Apr. 25, 1960. (Title varies)

Also published in Jour. Chem. Phys., v. 33: 1107-1111, Oct. 1960.

The electron spin resonance spectrum of vanadyl ion in solutions has the interesting feature that the linewidths of the individual hyperfine components depend on the

nuclear spin orientation, m_I. An analysis revealed that the origin of the effect is the mechanism proposed by H. M. McConnell (Jour. Chem. Phys., v. 30: 591, 1959) namely, that the existence of a "microcrystal" about the VO^{++} ion which gives rise to anisotropies in the g-tensor and hyperfine interaction. By comparing the results of linewidth measurements made at 9.25 kmc and at 24.3 kmc with the results of calculations made by D. Kivelson (Jour. Chem. Phys., v. 27: 1087, 1957) the validity of the microcrystallite model was established. (Contractor's abstract)

2533

Stanford U. Dept. of Physics, Calif.

ANALYSIS OF A MAGNETIC RESONANCE SPECTROMETER, by J. P. Goldsborough and M. Mandel. June 1960 [13]p. incl. diagrs. (Technical note no. 5) (AFOSR-TN-60-533) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)131 and National Science Foundation) AD 238355; PB 143412 Unclassified

Also published in Rev. Scient. Instr., v. 31: 1044-1046, Oct. 1960.

This paper analyzes an electron paramagnetic resonance microwave bridge spectrometer. Expressions are given for the relation between the signal and the imaginary part of the magnetic susceptibility. The essential feature of this application is that the voltage change across the circuit to which the sample is coupled is used to calculate the output of the detector. Only the observation of the imaginary part of the susceptibility is treated since this is the most common case. It is pointed out that the analysis can be applied to other systems with only a change in the symbols.

2534

Stanford U. Dept. of Physics, Calif.

THE SPECIFIC HEAT OF THE EXCHANGE SYSTEM OF SOME FREE RADICALS BETWEEN 1.6°K AND 4.2°K, by J. P. Goldsborough, M. Mandel, and G. E. Pake. June 1960 [8]p. incl. diagrs. table. (Technical note no. 6) (AFOSR-TN-60-585) (Also bound with its AFOSR-TN-60-533; AD 238355) (Sponsored jointly by Air Force Office of Scientific Research under AF 18-(603)131 and National Science Foundation) Unclassified

Also published in Proc. Seventh Internat'l. Conf. on Low Temperature Physics, Toronto U. (Canada) (Aug. 29-Sept. 3, 1960), Toronto, Toronto U. Press, 1961, p. 702-705.

Experiments are described which investigated the existence of some short range order in the spin system at liquid helium temperatures as observed in measurements of paramagnetic relaxation time in α-α-diphenyl β-picryl hydrazyl (DPPH), α,α-bisdiphenylene β-phenyl allyl (BDPA) and picryl-N-amino carbazyl. The idea of short range order and the determination of a value for J (the exchange integral) are confirmed. Specific heat determinations are made with a mechanical "heat switch" adiabatic calorimeter.

2535

Stanford U. Dept. of Physics, Calif.

PROTON RESONANCE SHIFTS IN DIPHENYL PICRYL HYDRAZYL, by M. E. Anderson, G. E. Pake, and T. R. Tuttle, Jr. July 1960 [9]p. incl. diagrs. tables. (Technical note no. 7) (AFOSR-TN-60-736) (AF 18(603)131) AD 242742; PB 150377 Unclassified

Also published in Jour. Chem. Phys., v. 33: 1581-1583, Nov. 1960.

Experiments in the 4.2° to 1.4°K range clearly revealed shifted components and the 1/T dependence of these shifts. Deuterium substitution experiments permitted explicit identification of one of the shifted components. The 4.2°K proton resonance absorption spectrum of a polycrystalline sample of the 1:1 α,α-diphenyl-β-picryl hydrazyl-benzene complex revealed a large central component owing to the benzens protons. Both upfield and downfield shifted components were evident, providing an illustration of the existence of spin densities of both signs at proton sites in the molecules. Deuteration substitution resulted in a spectrum in which the intensity of the component having the largest downfield shift, was reduced

2536

Stanford U. Dept. of Physics, Calif.

PROTON RESONANCE SHIFTS IN PYRENE MONONEGATIVE ION AT 4.2°K, by M. E. Anderson, P. J. Zandstra, and T. R. Tuttle, Jr. Aug. 1960 [5]p. incl. diagr. table. (Technical note no. 8) (AFOSR-TN-60-904) (AF 18(603)131) AD 242738 Unclassified

Also published in Jour. Chem. Phys., v. 33: 1591-1592, Nov. 1960.

The proton resonance shifts of solid potassium pyrenide at 4.2°K give evidence for both positive and negative hyperfine coupling constants. Values for the constants calculated from these shifts were compared with the isotropic couplings determined by Hoijtink, Townsent and Weissman (Jour. Amer. Chem. Soc., v. 78: 116, 1956) from the analysis of the ESR absorption spectrum of the ion in dilute solution. The proton resonances were not completely resolved, but the estimated areas under the absorption curves are consistent with an assumed correspondence between the two sets of results. It was thought that the positive coupling constant should be attributed to protons 2 and 7, and the negative ones to the

other protons. The meaning of the constants was doubtful owing to uncertain factors such as the contributions of anisotropic interactions and the effect of residence in the crystal lattice on the molecular wave functions.

2537

Stanford U. Dept. of Physics, Calif.

CRYSTAL ROTATOR FOR CRYOSTAT, by R. H. Webb and R. B. Griffiths. Nov. 1960 [3]p. incl. diagr. (Technical note no. 9) (AFOSR-TN-60-1457) (AF 18(603)131) AD 251923 Unclassified

Also published in Rev. Scient. Instr., v. 32: 363-364, Mar. 1961.

A simple mechanism of negligible heat leak used to rotate single crystals in an ESR microwave cavity is described. Some other uses in an ESR spectrometer are cavity tuning and coupling adjustment.

2538

Stanford U. [Dept. of Physics] Calif.

RATIO OF SECULAR TO NONSECULAR BROADENING FOR EXCHANGE-NARROWED PARAMAGNETIC RESONANCES (Abstract), by G. E. Pake. [1960] [1]p. [AF 18(603)131] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 252, Apr. 25, 1960.

When the frequency of paramagnetic resonance is less than the correlation frequency describing the random modulation of the interactions responsible for line broadening, there are additional "nonsecular" contributions to the line width. For dipolar interactions, a motionally or exchange-narrowed line is broadened to 10/3 of its secular width (10/3 effect). Calculations are presented which show that, if appreciable hyperfine interaction is present, the ratio departs from 10/3. Values of the ratio will be given in terms of the relative amounts of isotropic and anisotropic hyperfine coupling; for purely isotropic coupling it is 2. Comparisons will be made with the measurements of Rogers, Anderson, and Pake on solutions of stable free radicals.

2539

Stanford U. Dept. of Physics, Calif.

A TEST OF APPROXIMATION METHODS IN POTENTIAL SCATTERING, by J. D. Bjorken and A. Goldberg. Feb. 1960, 21p. incl. diagrs. refs. (Technical note no. 11) (AFOSR-TN-60-167) (AF 49(638)388) AD 233740; PB 146419 Unclassified

Also published in Nuovo Cimento, Series X, v. 16: 539-548, May 1, 1960.

Various approximation procedures fashionable in field theory for computing scattering amplitudes are tested on a soluble problem in potential theory, i.e., the s-wave scattering by an exponential potential. The methods include: (1) the Fredholm, or determinantal, expansion; (2) the Chew-Mandelstam procedure of constructing the scattering amplitude T_0 from analyticity properties and unitarity; (3) expansion of T_0 in powers of the potential strength λ (Born approximation); (4) expansion of $\tan \delta_0$ in powers of λ; and (5) expansion of $\cot \delta_0$ in powers of λ. Each is carried out in first and second order of approximation and compared with the exact result. The results are displayed in terms of effective-range plots of $k \cot \delta_0$ vs energy. In addition, the energies of bound states as predicted by the approximations are compared with the exact result. Approximations (1), (2), and (5) in second order are comparable in accuracy, agree reasonably well with the exact result, and are appreciably better than (3) and (4). The binding energy of the first bound state is predicted well by method (2) in second order, and at best qualitatively by the other methods. All methods except (1) predict existence of bound states for repulsive potentials. In second order method (1) predicts no bound state for any value of λ. (Contractor's abstract)

2540

Stanford U. Dept. of Physics, Calif.

HIGH ENERGY LIMIT OF FORM FACTORS, by S. D. Drell and F. Zachariasen. Feb. 1960, 17p. incl. diagrs. (Technical note no. 13) (AFOSR-TN-60-183) (AF 49-(638)388) AD 233743; PB 146420 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 284, Apr. 25, 1960.

Also published in Phys. Rev., v. 119: 463-466, July 1, 1960.

The following theorem is proved: for finite charge renormalization constant Z_S^{-1}, the form factors describing any vertex with 2 particles on the mass shell must vanish at infinite momentum transfer. The relation of this result to the work of Lehmann, Symanzik, and Zimmerman (Nuovo Cimento, v. 2: 425, 1955) is discussed. (Contractor's abstract)

2541

Stanford U. Dept. of Physics, Calif.

COUPLED INTEGRAL EQUATIONS FOR THE NUCLEON AND PION ELECTROMAGNETIC FORM FACTORS, by M. Baker and F. Zachariasen. Feb. 1960 [45]p. incl. diagrs. (Technical note no. 10) (AFOSR-TN-60-184) (AF 49(638)388) AD 233730; PB 147334 Unclassified

Presented at meeting of the Amer. Phys. Soc., Honolulu, Hawaii, Aug. 27-29, 1959.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 4: 368, Aug. 27, 1959.

Also published in Phys. Rev., v. 119: 438-448, July 1, 1960.

The dispersion relations for the nucleon isotopic vector form factors and the pion form factor which take into account contributions from both the 2π and NN intermediate states become a set of coupled integral equations for the form factors if the four amplitudes ($\pi\pi/NN$) ($\pi\pi/\pi\pi$) ($NN/\pi\pi$) (NN/NN) are assumed known. If these 4 amplitudes are replaced by their Born approximation values and spin and certain kinematic factors are neglected, the resulting set of coupled singular integral equations can be solved exactly. Comparison of these exact solutions with the form factors obtained from the usual approximation of retaining only the lowest mass state (i.e. the 2π state) confirms the hope that high mass states do not contribute much to dispersion integrals. It is also of interest that these solutions are obtained from dispersion relations without subtractions and satisfy the necessary conditions that they vanish at infinite momentum transfer and take on the value e at the origin for all values of the coupling parameters appearing in the equations.

2542

Stanford U. Dept. of Physics, Calif.

ON A POSSIBLE NEW EXPERIMENTAL TEST OF GENERAL RELATIVITY THEORY, by L. I. Schiff. Feb. 1960, 7p. (Technical note no. 12) (AFOSR-TN-60-199) (AF 49(638)388) AD 233744; PB 147616 Unclassified

Also published in Phys. Rev. Ltrs., v. 4: 215-217, Mar. 1, 1960.

An experiment to test the general theory of relativity is proposed. The test consists of observation of the precession of the axis of a torque-free gyroscope that is either fixed in a laboratory (rotating with the earth), or located in a satellite. The expected precession which arises from a combination of the gravitational field of the stationary earth, the effect of earth rotation (Lense and Thirring), and the Thomas precession, is of the order 6×10^{-9} radians per day for the earth bound gyroscope, and several times larger in the satellite case. A gyroscope made of a superconducting sphere supported by a static magnetic field is suggested for the experiment, and possibly for an experimental investigation of Mach's principle.

2543

Stanford U. Dept. of Physics, Calif.

CONSTRUCTION OF COUPLED SCATTERING AND PRODUCTION AMPLITUDES SATISFYING ANALYTICITY AND UNITARITY, by J. D. Bjorken. Apr. 1960, 6p. (Technical note no. 14) (AFOSR-TN-60-394) (AF 49-(638)388) AD 236176; PB 146875 Unclassified

Also published in Phys. Rev. Ltrs., v. 4: 473-474, May 1, 1960.

A description is given of a practical method for computing coupled scattering and production processes within the framework of dispersion theory. The methods of Omnes and of Chew and Mandelstam for constructing single channel (e.g. partial wave) scattering amplitudes, production amplitudes, and vertex functions on the basis of analyticity and unitarity are applied to the case of n^2 coupled amplitudes $T_{ij}(\omega)$ representing the production and scattering among n different channels, each of which may have a different threshold energy. The unitarity conditions for the amplitudes T_{ij} and, correspondingly, vertex functions F_j are given. $T_{ij}(\omega)$ and $F_j(\omega)$ are expressed in terms of functions $r_{ij}(\omega)$ which are analytic in some region R surrounding it. Applications are being made to double pion production, associated production and $K^- - N$ scattering.

2544

Stanford U. Dept. of Physics, Calif.

PHOTOEFFECT FROM THE L SHELL, by R. H. Pratt. Apr. 1960 [36]p. incl. tables, refs. (Technical note no. 15) (AFOSR-TN-60-417) (AF 49(638)388) AD 236781; PB 147356 Unclassified

Also published in Phys. Rev., v. 119: 1619-1626, Sept. 1, 1960.

The differential cross section for photoeffect from an atomic shell is shown to be almost independent of principal quantum number, apart from normalization, for energies well above threshold. The high-energy limits of the total cross sections for the three L subshells are calculated exactly with methods previously applied to the K shell, and extrapolations are made to cover the entire high-energy region. A procedure is indicated to account for the effects of electron screening. It is found that the contribution from the p shells is not negligible in heavy elements. Agreement with experiment is good.

2545

Stanford U. Dept. of Physics, Calif.

MOTION OF A GYROSCOPE ACCORDING TO EINSTEIN'S THEORY OF GRAVITATION, by L. I. Schiff. Apr. 1960 [28]p. incl. refs. (Technical note no. 17) (AFOSR-TN-60-449) (AF 49(638)388) AD 236781; PB 147365 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 46: 871-882, June 1960.

It is pointed out that only the precession of the perihelion of the orbit of the planet Mercury provides an experimental verification of general relativity theory that goes beyond special relativity and the equivalence principle. To provide the theoretical basis for a new experimental test of the theory, the properties of a spinning test particle, or torque-free gyroscope, are calculated in detail. The magnitude of the spin angular momentum of the gyroscope is shown not to change, so that its frequency of rotation, as measured by a co-moving observer, is constant. However, there is a precession of its spin axis with respect to the inertial frame determined by the distant "fixed stars". This has 3 parts to it: (1) the Thomas precession, a special relativity effect; (2) the gravitational effect discussed by de Sitter, Fokker and Pirani, which occurs regardless of whether or not the earth is rotating; and (3) an effect like that discussed by Lense and Thirring, which is caused by the rotation of the earth. The magnitude is about 6×10^{-9} radians per orbital revolution of the gyroscope, a revolution requiring a day if the gyroscope is at rest in an earth-bound laboratory, or about an hour and a half if the gyroscope is in a satellite at moderate altitude. This is very small, but perhaps measurable. (Contractor's abstract)

2546

Stanford U. Dept. of Physics, Calif.

HIGH ENERGY ELECTRON-ELECTRON SCATTERING, by Y.-S. Tsai. May 1960 [68]p. incl. diagrs. tables, refs. (Technical note no. 16) (AFOSR-TN-60-546) (AF 49(638)388) AD 238059; PB 148163 Unclassified

Also published in Phys. Rev., v. 120: 269-286, Oct. 1, 1960.

The radiative corrections to the electron-electron scattering to order α^3 are calculated for (1) the colliding beam experiment and (2) the experiment in which the target electron is at rest initially. The contributions from high energy real photons are included. The two photon exchange diagrams are found to give only negligible contributions to the cross sections after infrared cancellation. The effect due to the possible breakdown of quantum electrodynamics is discussed. A preliminary study on the electron-positron colliding beam experiment involving various interactions is made. The vacuum polarizations involving heavier particles than an electron pair in the closed loop are investigated. (Contractor's abstract)

2547

Stanford U. Dept. of Physics, Calif.

OBSERVATION OF π-π RESONANCE IN PION PRODUCTION, by S. D. Drell and F. Zachariasen. June 1960, 10p. incl. diagrs. (Technical note no. 20) (AFOSR-TN-60-645) (AF 49(638)388) AD 240550; PB 149576 Unclassified

Also published in Phys. Rev. Ltrs., v. 5: 66-68, July 15, 1960.

A method is described for observing π-π resonance in pion production experiments. The analysis of the reactions $\gamma + n \rightarrow \pi + \pi + n$ and $\pi + n \rightarrow \pi + \pi + n$ is suggested. Separation of the final state interaction of the pions from the total process is extremely difficult due to the strong interaction of each pion with the recoil nucleon. The solution proposed is to hold the π-n interaction constant by a suitable choice of the kinematics, so that the variations in the cross sections would be due to variations in the π-π interaction.

2548

Stanford U. Dept. of Physics, Calif.

QUENCHING OF MAGNETIC MOMENTS IN NUCLEI, by S. D. Drell and J. D. Walecka. June 1960 [41]p. incl. diagrs. table, refs. (Technical note no. 19) (AFOSR-TN-60-714) (AF 49(638)388) AD 240551 Unclassified

Also published in Phys. Rev., v. 120: 1069-1078, Nov. 1, 1960.

The premise that modern dispersion-theoretical techniques provides a reliable method for calculating the anomalous magnetic moment of a nucleon is used as a basis for calculating the modification or quenching of the moment for a nucleon in nuclear matter. The effect considered in the study is due to the fact that nucleons are not allowed by the exclusion principle to recoil into states already occupied by other nucleons in the nucleus. The actual technique used in the calculation is to sum all the Feynman diagrams that are included in the dispersion theory calculation of the single nucleon moment. The nucleon propagator is then written as a sum over states, and those states are removed in which the nucleon is inside the Fermi sea. The result is that the anomalous moment is reduced by $\sim 7\%$.

2549

Stanford U. Dept. of Physics, Calif.

THE DECAY $\Sigma^0 \rightarrow \Lambda^0 + e^+ + e^-$ AND THE $\Sigma^0 - \Lambda^0$ RELATIVE PARITY, by N. Byers. July 1960, 10p. (Technical note no. 22) (AFOSR-TN-60-769) (AF 49-(638)388) AD 240549; PB 149577 Unclassified

The method of analysis by Kroll and Wada (Phys. Rev., v. 98: 1355, 1955) used on the direct production of electron-positron pairs with the associated possibility of intermediate state real photons by internal conversion in processes of the type $A \rightarrow (B + \gamma) \rightarrow B + e^+ + e^-$ is applied to the process $\Sigma^0 \rightarrow (\Lambda^0 + \gamma) \rightarrow \Lambda^0 + e^+ + e^-$. It is found that the photons which undergo internal conversion tend to be transverse with electric vector normal to the plane of the electron-positron pair. It is shown that if the Σ^0 and Λ^0 have equal spin, the internal conversion of the photons in decays of polarized Σ^0's offers a means of measuring the $\Sigma^0 - \Lambda^0$ relative parity.

2550

Stanford U. Dept. of Physics, Calif.

HIGH-FREQUENCY REGION OF THE BREMSSTRAHLUNG SPECTRUM, by R. H. Pratt. July 1960, 24p. incl. tables, refs. (Technical note no. 21) (AFOSR-TN-60-823) (AF 49(638)388) AD 240903; PB 149797 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 232, Apr. 25, 1960. (Title varies)

Also published in Phys. Rev., v. 120: 1717-1722, Dec. 1, 1960.

The McVoy-Fano theory (Phys. Rev., v. 116: 1168, 1959) of the connection between the atomic photoelectric effect and the high-frequency region of the bremsstrahlung spectrum was extended to next order in αZ. The contribution from P states is determined and is important in heavy elements. Predictions for the high-frequency limit are in reasonable agreement with experiment. Information is also obtained concerning angular distributions and polarization correlations. (Contractor's abstract)

2551

Stanford U. Dept. of Physics, Calif.

GROUND STATES OF ODD-ODD NUCLEI, by A. deShalit and J. D. Walecka. July 1960, 10p. incl. table. (Technical note no. 23) (AFOSR-TN-60-837) (AF 49-(638)388) AD 240904; PB 149798 Unclassified

Also published in Phys. Rev., v. 120: 1790-1792, Dec. 1, 1960.

The spectrum of odd-odd nuclei is investigated with a general interaction of the type $V_0 + \sigma_1 \cdot \sigma_2 V_1$. It is shown that an inspection of the properties of some Racah coefficients is enough to determine the ground-state spin for particle-particle or hole-hole configurations in most cases. The results agree qualitatively with empirical evidence summarized by Brennan and Bernstein if V_0 and V_1 are both attractive; this agreement is insensitive to the range and other details of either V_0 or V_1.

2552

Stanford U. Dept. of Physics, Calif.

NEUTRON-PROTON PAIRING INTERACTION, by A. N. Saxena. Aug. 1960, 18p. incl. diagrs. refs. (Technical note no. 26) (AFOSR-TN-60-1133) (AF 49(638)388) AD 246634; PB 153186 Unclassified

Also published in Phys. Rev., v. 121: 595-599, Jan. 15, 1961.

The neutron-proton pairing interaction λ between the last odd neutron and the last odd proton in the outermost neutron and proton shells of a nucleus has been estimated in the regions $Z > 20$, $N > 20$ and $Z > 40$, $N > 50$. Behavior of λ in these 2 regions and in the heavy nuclei region $Z > 82$, $N > 126$, as estimated by Ghoshal and Saxena, is discussed. Also, it is shown that λ arises due to the Wigner force and it is proportional to $(2j_1 + 1 - 2z)(2j_2 + 1 - 2n)$, where Z is the odd number of protons in the outermost proton shell j_1, and n is the odd number of neutrons in the outermost neutron shell j_2 of the odd-odd nucleus. (Contractor's abstract)

2553

Stanford U. Dept. of Physics, Calif.

PION PARAMETERS FROM HIGH ENERGY INELASTIC INTERACTIONS, by S. D. Drell. Aug. 1960 [9]p. incl. diagrs. (Technical note no. 25) (AFOSR-TN-60-1134) (AF 49(638)388) AD 246633; PB 153185 Unclassified

Also published in Phys. Rev. Ltrs., v. 5: 342-344, Oct. 1, 1960.

The physical principle that a transition amplitude has a pole for real one-particle intermediate states is applied to various experimental arrangements with the aim of evaluating their quantitative content and of using them to determine pion interaction constants. (Contractor's abstract)

2554

Stanford J. Dept. of Physics, Calif.

PSEUD-CLUSTER EXPANSION. II. APPLICATION TO SINGLE-PARTICLE NUCLEAR MATRIX ELEMENT, by J.-I. Fujita. Aug. 1960, 13p. incl. refs. (Technical note no. 29) (AFOSR-TN-60-1135) (AF 49(638)388) AD 246636 Unclassified

Possible corrections due to the short range correlations to a single-particle nuclear matrix element are discussed from the viewpoint of the cluster expansion method. The correction for the diagonal matrix element is usually 10%, at most, and the conventional calculation in the configuration mixing method is justified with good accuracy. The possible small effect can be expressed as (1 + D) (O,MO), where O is an asymptotic wave function in the model space and a superposition of low-lying shell states, M is a single particle operator and D stands for the effect of wave function normalization. It is shown that D is a positive quantity with the order of magnitude of 10% if M involves the radial coordinates of nucleons such as, the electric dipole or quadrupole moment. If M has no radial coordinate such as the magnetic moment or beta-decay moment in the allowed transitions, a negative correction due to the possible increase of the healing distance at the nuclear surface is possible. The relationship between the correlation functions and higher energy phenomena is also mentioned. (Contractor's abstract)

2555

Stanford U. Dept. of Physics, Calif.

PRODUCTION OF PARTICLE BEAMS AT VERY HIGH ENERGIES, by S. D. Drell. Aug. 1960 [13]p. incl. diagrs. (Technical note no. 28) (AFOSR-TN-60-1136) (AF 49(638)388) AD 246635; PB 153188 Unclassified

Also published in Phys. Rev. Ltrs., v. 5: 278-280, Sept. 15, 1960.

The physical principle that a transition amplitude has a pole for real one-particle intermediate states is used to study the photoproduction of secondary beams of high energy strongly-interacting particles. Photons were found to be much more effective in initiating collimated beams of high energy charged pions, K mesons, etc., than heretofore believed. This result is of interest in predicting and comparing yields from electron linacs, electron synchrotrons, and proton synchrotrons in the multi-bev range. (Contractor's abstract)

2556

Stanford U. Dept. of Physics, Calif.

SPECTRA OF ODD-ODD NUCLEI, by A. deShalit and J. D. Walecka. Aug. 1960 [37]p. incl. diagrs. tables, refs. (Technical note no. 24) (AFOSR-TN-60-1137) (AF 49(638)388) AD 246632; PB 153189 Unclassified

Also published in Nuclear Phys., v. 22: 184-201, Jan. 1961.

A general discussion of the spectra of odd-odd nuclei is presented. It was found useful to develop a new method for the calculation of energy levels. An explicit expression is derived for the distribution of the relative angle of the 2 particles, properly weighted according to the spin-dependence of the interaction. With the help of these expressions the general structure of spectra of odd-odd nuclei can be more clearly seen. In particular the modified Nordheim rules are seen to hold quite generally, and it is found that for configurations containing a half-filled shell the lowest state has an even or odd J according to whether its parity is odd or even. (Contractor's abstract)

2557

Stanford U. Dept. of Physics, Calif.

A NOTE CONCERNING THE MAGNETIC MOMENT OF THE MUON, by N. Byers and F. Zachariasen. Sept. 1960, 3p. (Technical note no. 27) (AFOSR-TN-60-1305) (AF 49(638)388) AD 249884 Unclassified

Also published in Nuovo Cimento, Series X, v. 18: 1289-1290, Dec. 16, 1960.

A calculation is reported of the effect on the magnetic moment of the muon due to vector boson intermediary for weak interactions. It is found that if the neutrinos in β- and μ-decay are identical, then the anomalous moment (μ_x) due to such a boson is less than 3 x 10^{-10} e/2m_μ, where m_μ is the mass of the muon. If the 2 neutrinos are not identical then $\mu_x \cong 10^{-9}$ e/2m_μ.

2558

Stanford U. Dept. of Physics, Calif.

RADIATIVE CORRECTIONS TO ELECTRON-PROTON SCATTERING, by Y.-S. Tsai. Nov. 1960 [34]p. incl. diagrs. refs. (Technical note no. 31) (AFOSR-TN-60-1366) (AF 49(638)388) AD 249886 Unclassified

Also published in Phys. Rev., v. 122: 1898-1907, June 15, 1961.

The radiative corrections to the electron-proton scattering are calculated with the effects of the proton recoil taken into account. The experimental conditions of Hofstadter et al. have been assumed, i.e., on the final electrons are momentum-analyzed. The anisotropy in the maximum energy of photons which can be emitted and the radiation from the proton current are the 2 main

effects due to the proton recoil, and both effects are considered. The mesonic effects in the 2 photon exchange diagrams are not considered. Other than the uncertainty in the mesonic effects, the formula is good up to about 5 bev. (Contractor's abstract)

2559

Stanford U. Dept. of Physics, Calif.

EFFECTIVE MOMENTS IN K^{39} AND K^{40}, by A. deShalit. Nov. 1960, 26p. incl. diagrs. table, refs. (Technical note no. 30) (AFOSR-TN-60-1435) (AF49-(638)388) AD 249885 Unclassified

Also published in Nuclear Phys., v. 22: 677-688, Feb. 1961.

By comparing magnetic moments of levels belonging to the same nucleon configuration in an odd-odd nucleus, or M1 transitions between such levels, an important information on the effective moments of bound nucleons can be obtained. This analysis is carried out for K^{40} and the results agree very well with the magnetic moment of K^{39}. An attempt is made to include the effects of configuration mixing in K^{40}, induced by the residual proton-neutron interaction. A δ-type interaction which produces the spectrum of Cl^{38} is assumed. Tho resulting agreement is considerably deteriorated, indicating that such an admixture of configurations is probably negligible in K^{40}. Further experiments are suggested to check the validity of the concept of an effective moment. (Contractor's abstract)

2560

Stanford U. Dept. of Physics, Calif.

PION-NUCLEON SCATTERING IN THE MANDELSTAM REPRESENTATION, by S. C. Frautschi and J. D. Walecka. Nov. 1960, 9p. incl. diagrs. (Technical note no. 18) (AFOSR-TN-60-1436) (AF 49(638)388) AD 249883 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 268-269, Apr. 25, 1960.

Also published in Phys. Rev., v. 120: 1486-1505, Nov. 15, 1960.

Using the analytic properties of partial wave scattering amplitudes, as derived from Mandelstam's representation, the J = 3/2, p state of the pion-nucleon system have been studied. The method used is covariant, it incorporates unitarity, and the effect of a possible pion-pion resonance has been investigated. Using the "single nucleon term" and the low-energy scattering properties of the "crossed states," a resonance in the J = 3/2, T = 3/2 pion-nucleon state without the aid of a cutoff is obtained. The scattering in the T = 1/2 state was also investigated. The pion-pion resonance appears to have only a very small effect in the T = 3/2 state whereas in the T = 1/2 state it increases the phase shift by a factor of 2. The resonance obtained in the T = 3/2 state occurs at too low an energy. This may be accounted for by the fact that contributions from crossed states and data on inelastic scattering have not been included.

2561

Stanford U. Dept. of Physics, Calif.

ELECTRON-PROTON BREMSSTRAHLUNG, by R. A. Berg and C. N. Lindner. Dec. 1960 [39]p. incl. diagrs. table, refs. (Technical note no. 32) (AFOSR-97) (AF 49(638)388) AD 613352; PB 155758 Unclassified

Presented at meeting of the Amer. Phys. Soc., California U., Berkeley, Dec. 29-31, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 506, Dec. 29, 1960.

Also published in Nuclear Phys., v. 26: 259-279, Aug. 1961.

The electron-proton bremsstrahlung cross section is calculated in first Born approximation, neglecting radiative corrections to the electron. As an extension of an earlier calculation, the proton Compton effect contribution is analyzed in its most general form. It will involve twelve form factors of three invariants: $f_j(\nu_1, \nu_2, \nu_3)$, (j = 1, ... ,12). The cross section is stated explicitly in terms of these twelve functions and the two form factors of one invariant describing the proton vertex. The contributions to the f_j from (a) the single nucleon intermediate state, (b) the one-meson, one-nucleon intermediate state and (c) the neutral pion exchange, are calculated. These three contributions are expected to be the major effects when the energies involved are in the range of present experimental interest. To order $(1/M)^2$, only three combinations of these twelve f_j will contribute to the cross section. When only (a) and (b) are considered, only two of these three combinations are independent. Some numerical values for a bremsstrahlung coincidence experiment are presented. (Contractor's abstract)

2562

Stanford U. Dept. of Physics, Calif.

LAMB SHIFT IN THE HELIUM ATOM, by C. Schwartz. Apr. 1960, 28p. incl. tables, refs. (Technical note no. 36) (AFOSR-661) (AF 49(638)388) AD 258394 Unclassified

Also published in Phys. Rev., v. 123: 1700-1705, Sept. 1, 1961.

The calculation, first attempted by Kabir and Salpeter (Phys. Rev., v. 108: 1256, 1957), of the mean excitation energy entering in the Lamb shift of the helium ground state is redone by a quite different approach. The recalculation, $\ln[k_0/r_y] = 4.370 \pm 0.004$, leaves theory and experiment on the ionization energy of helium in agreement within the experimental uncertainty of ± 0.15 cm^{-1}. Incidental results are given for the electrostatic polarizability of the He and H^- ground states. There is appended a new discussion of the construction of higher angular momentum eigenfunctions for the 3-body problem. (Contractor's abstract)

2563

Stanford U. [Dept. of Physics] Calif.

CHEW-MANDELSTAM APPROXIMATION AND OTHER APPROXIMATION PROCEDURES IN POTENTIAL SCATTERING (Abstract), by J. D. Bjorken and A. Goldberg. [1960] [1]p. [AF 49(638)388] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 51, Jan. 27, 1960.

Various approximation procedures fashionable in field-theoretic circles are tested in the special case of s-wave scattering by an exponential potential. In particular, for this case, the Chew-Mandelstam procedure of implementing the Mandelstam representation can be carried out analytically in any order of approximation. Considered are: (1) Chew-Mandelstam procedure; (2) the Fredholm (determinantal) expansion, expansions of (3) $\tan\delta$, (4) $\cot\delta$, and (5) $e^{i\delta}\sin\delta$ in power series in the potential strength, each in the first and second order of approximation. The results, expressed in terms of formulas for $k\cot\delta$, are compared with the exact solutions, which may be obtained analytically in terms of Bessel functions of imaginary order. Numerical results will be discussed. Preliminary computations indicate that the Chew-Mandelstam procedure is perhaps comparable in accuracy to the Fredholm expansion. All of the approximation procedures (in second order) give at best qualitative agreement for values of the potential strength strong enough to produce bound states.

2564

Stanford U. Dept. of Physics, Calif.

RADIATIVE CORRECTIONS TO THE ELECTRON-ELECTRON SCATTERING (Abstract), by Y.-S. Tsai. [1960] [1]p. [AF 49(638)388] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 256, Apr. 25, 1960.

Also published in Nuovo Cimento, Series X, v. 16: 370-372, Apr. 16, 1960.

Radiative corrections to e-e scattering are calculated assuming the following experimental conditions. The experiment, being performed by O'Neill et al. at Stanford, is done with a two intersecting 500-mev electron beams and is designed to test the validity of quantum electrodynamics at small distances down to $\sim 0.5 \times 10^{-14}$ cm. The detectors for scattered electrons are Cerenkov counters facing each other with equal circular apertures extending the same solid angle and arranged for coincidence. Cerenkov counters are assumed to have no energy resolution. Angular distributions from 35° to 90° are taken. The two-photon exchange diagrams (crisscross and non-crisscross) contribute negligible to the cross section (< 0.1%) after cancellation with the corresponding soft real photon contribution. Hence the soft real photon plus the elastic cross sections are essentially the same as Schwinger's corrections to the electron nucleus scattering with contributions from bremsstrahlung and vertex parts doubled but the vacuum polarization term undoubled. Assuming the half-angle of the counter to be 3.5°, the radiative corrections to the Møller cross section are found to be -8.1% and -4.8% at θ equal to 90° and 35°, respectively. Mesonic effects in the vacuum polarization are also calculated and found to be negligible.

2565

Stanford U. Dept. of Physics, Calif.

$\Sigma^0 \rightarrow \Lambda^0 + e^+ + e^-$ AND THE $\Sigma^0 - \Lambda^0$ RELATIVE PARITY, by N. Byers and H. Burkhardt. [1960] [2]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)388] and Atomic Energy Commission) Unclassified

Published in Phys. Rev., v. 121: 281-282, Jan. 1, 1961.

The $\Sigma^0 - \Lambda^0$ relative parity may be measured by observing correlation of polarizations in the process $\Sigma^0 \rightarrow \Lambda^0 + \gamma$. Internal conversion of the photon into an electron pair (Dalitz pair) serves as an analyzer which selects polarized photons. Theoretical results are presented which show that the Dalitz-pair decay mode of polarized Σ^0's may be used to measure the $\Sigma^0 - \Lambda^0$ relative parity. (Contractor's abstract)

2566

Stanford U. Div. of Engineering Mechanics, Calif.

ON THE OPTIMUM RESPONSE OF THIRD ORDER CONTACTOR CONTROL SYSTEMS, by I. Flügge-Lotz and M. Yin. Apr. 25, 1960, 135p. incl. diagrs. tables, refs. (Technical rept. no. 125) (AFOSR-TN-60-476) (AF 49(638)513) AD 239446; PB 148921 Unclassified

This investigation is concerned with the optimum response for contactor or relay control systems. The systems are described mathematically by second and third order differential equations with constant coefficients and with a discontinuous forcing term, ±N. The performance criterion is that the time interval required for the control system to reduce an initial disturbance to zero should be minimum. A brief summary is given of the maximum principle. The form of the optimum control for systems described by differential equations with constant coefficients and one control function is given as a function of time. The optimum control as a function of the variables of the system is derived for second order position controlled systems. Second order velocity controlled systems, which correspond to third order systems where one of the characteristic roots is zero are dealt with. Emphasis is placed on the cases where the other two characteristic roots are complex conjugates. An iteration method is presented which will yield the optimum solution for cases where the real part of the complex roots are zero. If the periodic approximation is used, the procedure will yield a nearly optimum solution for the more general case. Various examples are given to exhibit the solution. Although the examples are demonstrated graphically, the procedure should be adaptable to machine computation. A quasi-optimum switching surface is proposed at the end of this chapter to handle initial disturbances having comparatively small error derivatives. Third order position controlled systems are discussed briefly. Difficulties one might encounter in the application of the iteration method are pointed out. A dual mode approximation is given for cases where the nonzero negative real characteristic root is much larger than the real part of the complex roots.

2567

Stanford U. Div. of Engineering Mechanics, Calif.

THE OPTIMUM RESPONSE OF SECOND-ORDER, VELOCITY-CONTROLLED SYSTEMS WITH CONTACTOR CONTROL, by I. Flügge-Lotz and M. Yin. [1960] [6]p. incl. diagrs. tables, refs. (AFOSR-3437) (AF 49-(638)513) AD 612337 Unclassified

Presented at Joint Automatic Controll Conf., Cambridge, Mass., Sept. 7-9, 1960.

Also published in Jour. Basic Eng., v. 83: 59-64, Mar. 1961.

An iteration method is shown which will yield solution to the problem for second-order, velocity-controlled systems. If the switching curves used in the iteration are derived from the equation, $u(\tau) = \text{sgn}\,[C' e^{\zeta\tau} - \cos(\nu\tau + \delta')]$, the solution will be optimum. If the switching curves used in the iteration are periodic approximations then the solution will be nearly optimum. By means of the present scheme certain features of the second-order, velocity-controlled systems with complex roots can be exhibited. If the second-order, position-controlled systems considered by Bushaw (Optimal Discontinuous Forcing Terms, Contributions to the Theory of Nonlinear Oscillations, Princeton University Press, v. 4: 29-52, 1958) can be realized at all, then the present scheme presents no special difficulty in its realization. It is mentioned that, for third-order systems whose characteristic equation has real roots only, the optimum switching criterion can be expressed in a much simpler way as a function of the phase variables.

2568

Stanford U. Div. of Engineering Mechanics, Calif.

DEVELOPMENT OF A FINITE-DIFFERENCE METHOD FOR COMPUTING A COMPRESSIBLE LAMINAR BOUNDARY LAYER WITH INTERACTION, by I. Flügge-Lotz and E.-Y. Yu. May 15, 1960, 132p. incl. diagrs. tables, refs. (Technical note no. 127) (AFOSR-TN-60-577) (AF 49(638)550) AD 242421; PB 150340 Unclassified

The finite-difference method has been used by Baxter and Flügge-Lotz (STA.04:002, Vol. II) in solving the compressible boundary layer equations in Crocco's form, ie., with shear stress τ, and enthalpy i, as dependent variables and the coordinate x, and the velocity u, parallel to the body surface, as independent variables. The interaction problem of the boundary layer and the exterior flow are handled with the equations in the original form, with u and i as dependent variables and x and y as coordinates. The derived solution gives detailed view of the behavior of the flow within the boundary layer without any coordinate retransformation. Boundary layer calculation attempts are described.

2569

Stanford U. High-Energy Physics Lab., Calif.

PHOTOPROTONS FROM MEDIUM AND HEAVY ELEMENTS, by W. C. Barber and V. J. Vanhuyse. Jan. 8, 1960 [41]p. incl. diagrs. tables, refs. (Rept. no. HEPL-175) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under N6onr-25116) Unclassified

Also published in Nuclear Phys., v. 16: 381-401, May 1, 1960.

Energy and angular distributions of protons produced by electron bombardment of targets of Nb, In, Ta, and

Au were measured. Yield curves as a function of electron energy up to 40 mev were measured for Nb, In, and Ta. The angular distributions are strongly forward for Ta and Au, less so for Nb, and slightly backward for In. The energy distributions are fairly smooth functions except in the case of Ta where two peaks are observed at about 9.5 and 11.5 mev. The yields were analyzed by means of a calculated number of photons (real and virtual) accompanying the electron through the target, and the following photoproton cross sections integrated over photon energy were obtained: Nb, 230 mev-mb; In, 90 mev-mb; Ta, 60 mev-mb; and Au, 75 mev-mb; the results have an estimated accuracy of ± 25%. (Contractor's abstract)

2570

Stanford U. High-Energy Physics Lab., Calif.

WIDE RANGE MARGINAL OSCILLATOR FOR OPERATING NUCLEAR RESONANCE PROBES THROUGH FLEXIBLE CABLE, by L. Buss and L. Bogart. [1959] [2]p. incl. diagr. (Rept. no. HEPL-184) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116]) Unclassified

Published in Rev. Scient. Instr., v. 31: 204-205, Feb. 1960.

The design of an oscillator constructed to facilitate frequencies in the range of 47 to 55 mc utilizing resonance absorption methods is presented. The desirable features of a Colpitts oscillator were grafted onto a Franklin oscillator. A condenser and choke were provided to keep audio off the oscillator grid; the second grid was grounded, and oscillation level changes were taken from the first plate. Pickup was reduced by heating the filaments with dc from the plate supply, the current drain being only about 50 ma. The resulting simple current proved to have excellent frequency stability, high signal-to-noise ratios without a special filament supply, and a wide range of stable oscillation. The crystal can be used to control at odd overtones as well as at the fundamental frequency.

2571

Stanford U. High-Energy Physics Lab., Calif.

TRANSISTORS AS HIGH-SPEED LIGHT PULSES, by E. W. Kendall. Mar. 2, 1960, 4p. (Rept. no. HEPL-194) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116]) Unclassified

Presented at Scintillation Symposium, Washington, D. C., Feb. 1959.

Published in I.R.E. Trans. on Nuclear Sci., v. NS-7: 202-203, July-Sept. 1960.

The emission of light from transistor junctions is investigated in order to design a light source constructed from commercially available components which would duplicate the light pulse from Cerenkov radiation or scintillation in a phosphor. In order to be useful in the testing of scintillation counter telescopes using fast coincidence circuitry, the light pulses from a solid-state light pulser should rise in no more than 1 to 2 nsec. From the properties of the photomultiplier and associated equipment, it was estimated that the rise time of the light pulse was no more than 1.5 nsec for all the junctions investigated, with the use of an electrical pulse of 1-nsec rise time. Continued operation for several hours at pulse amplitudes above 50 v rendered almost all of the base-emitter junctions useless and degraded the performance of the base-collector junctions. Under optimum conditions the light pulsers gave rise to the emission of approximately 80-200 photoelectrons from the photomultiplier cathode during 4-nsec light pulse. A single junction does not furnish enough light to simulate exactly the light output from plastic scintillators in which more than 100 kev has absorbed. The junctions can, however, be operated in series or in parallel to increase the light output.

2572

Stanford U. [High-Energy Physics Lab.] Calif.

STRUCTURE OF THE DEUTERON FROM COHERENT π^0 PHOTOPRODUCTION (Abstract), by J. I. Friedman and H. W. Kendall. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission and Office of Naval Research under [N6onr-25116]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 236, Apr. 25, 1960.

Coherent photoproduction of π^0 mesons from deuterium is sensitive to the structure of the deuteron form factor. Absolute measurements of the production cross section have been completed for photon energies from 470 to 510 mev by detecting momentum-analyzed recoil deuterons. The deuteron factor has been determined in the range of momentum transfers from 1.75 to 2.75 fermi^{-1}. An impulse approximation calculation, including only the deuteron S state, gives a structure form factor consistent with the predictions of a repulsive core potential. There is a large reduction of the production cross section for photon energies near the 3.3 production resonance with respect to the impulse approximation prediction. This is in qualitative agreement with calculated corrections arising from multiple scattering of the meson in the deuteron. Theoretical analysis now in progress will allow a more complete interpretation of the experiment.

2573

Stanford U. [High-Energy Physics Lab.] Calif.

DETERMINATION OF THE MAGNETIC STRUCTURE OF THE NEUTRON (Abstract), by H. W. Kendall, J. I. Friedman, and P. [A.][M.]Gram. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N8onr-25116]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 270, Apr. 25, 1960.

Elastic electron-scattering experiments from deuterium, at constant four-momentum transfer q, yield information on the magnetic moment structure of the deuteron. This information can be related, by the impulse approximation and the experimental result that $F_{1p} \cong F_{2p}$, to $F_{1n} = 0$. Measurements have been completed for q in the range from 1.0 to 2.8 fermi^{-1}. The magnetic form factor of the neutron is, within the experimental error, the same as that of the proton's anomalous magnetic moment for q from 1.6 to 2.25 fermi^{-1}. The average of the ratio of form factors over the measured interval is (0.905 ± 0.08). Measurements of the transition form factor for the electron disintegration of the deuteron near threshold have also been completed. Determination of the deuteron's charge structure are in agreement with earlier work.

2574

Stanford U. [High-Energy Physics Lab.] Calif.

ELECTRON-SCATTERING INVESTIGATION OF THE ANOMALOUS LEVELS IN LEAD, BISMUTH, NICKEL, AND COBALT (Abstract), by H. Crannell, R. Helm and others. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 270, Apr. 25, 1960.

The form factors for elastic and inelastic scattering of electrons from Co^{59}, Ni^{58}, Ni^{60}, Pb^{208}, and Bi^{209} have been measured. Nuclear excitations up to 6 mev were studied; the levels seen by Cohen were observed. The scattering from Pb^{208} and Bi^{209} is qualitatively similar. The form factors of the 4.3-mev anomalous level scattering differ qualitatively from that of the 2.6-mev levels, but the results do not exclude 3^- assignments for the 4.3 level. Assuming all the states to be 3^- preliminary estimates are obtained of (3.8 ± 1.0) x 10^{10} sec^{-1} for the ground-state transition rates for the 2.6 mev levels, and (0.88 ± 0.35) x 10^{12} sec^{-1} for the ground-state transition rates for the anomalous levels. The scattered spectra from Co^{59}, Ni^{58}, and Ni^{60} show strong similarities to one another. In Ni^{60} preliminary estimates are obtained of (1.5 ± 0.7) x 10^{12} and (1.3 ± 0.7) x 10^{4} sec^{-1} for the 1.33(2^+) and 2.50(4^+) ground-state transition rates. Taking Crut and Wall's assignment of 3^- for the anomalous level at (4.05 ± 0.1) mev in Ni^{60}, (3.0 ± 1.0) x 10^{10} sec^{-1} for the ground-state transition rate are obtained.

2575

Stanford U. [High-Energy Physics Lab.] Calif.

INELASTIC ELECTRON SCATTERING FROM LEVELS OF LIGHT NUCLEI (Abstract), by F. Berthold, W. C. Barber and others. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6-onr-25116]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 271, Apr. 25, 1960.

The electron energy resulting from the scattering of 40-mev primary electrons at angles of 132° and 160° from targets of Li^6, Be, and Si was measured. A virtual photon theory is used to relate the areas of inelastic peaks to the integrated cross section for γ absorption. For Li^6, peaks corresponding to excitation of the states at 2.18 and 3.56 mev were observed. The 3.56-mev peak showed an angular dependence within 4% of that predicted theoretically for an M-1 transition. The 2.18-mev peak has a different angular dependence which is within experimental error of that predicted for an E-2 transition. By using these assignments for the transitions, the integrated cross sections were calculated to be (6.0 ± 0.3) x 10^{-28} and (8 ± 4) x 10^{-31} mev-cm^2 for the 3.56- and 2.18- mev levels, respectively. The corresponding radiation widths are 5.9 and 4.1 x 10^{-4} ev. Several levels are observed in Be. Si shows a prominent one at 11.6 mev.

2576

Stanford U. [High-Energy Physics Lab.] Calif.

INELASTIC ELECTRON SCATTERING FROM THE GIANT RESONANCE REGION OF NUCLEI (Abstract), by W. C. Barber, F. Berthold and others. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific

Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116]) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 271, Apr. 25, 1960.

Observations revealed peaks in the energy spectra of electrons scattered at 160° from targets of C, Si, and Pb at excitation energies of 23, 20, and 15 mev from the targets, respectively. The excitation energies and peak widths are consistent with the giant resonances for these nuclei. The areas of the inelastic peaks are related to the integrated cross sections for γ absorption through the theory of virtual photons. A previous result that this analysis gave a too small cross section for the C resonance is at least partly corrected by recent measurements indicating a decrease of detector efficiency with decreasing electron energy. When the data are corrected for this dependence, the resulting integrated cross sections are: C, 80 mev-mb; Si, 120 mev-mb; Pb, 6000 mev-mb. The results are uncertain by a factor of approximately 2 because they depend on arbitrary assumptions about nuclear form factors and arbitrary methods used in subtracting the continuum of low energy electrons. By measuring at larger scattering angles it is hoped to alleviate this second difficulty.

2577

Stanford U. High-Energy Physics Lab., Calif.

ELECTRODISINTEGRATION OF Ta AND Au NUCLEI, by W. C. Barber and T. Wiedling. Apr. 26, 1960 [26]p. incl. diagrs. refs. (Rept. no. HEPL-192) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under N6onr-25116) Unclassified

Also published in Nuclear Phys., v. 18: 575-586, Sept. 1960.

Yield curves were measured for the production of 5.6-day Au^{196} and 30-sec Au^{195} from Au^{197}, and of 8.1-hr Ta^{180}, 2.1-hr Ta^{178}, and 9.3-min Ta^{178} from Ta^{181}, in foil stacks which were bombarded by electrons. The results were analyzed to compare the yields resulting from the direct effect of the electrons with those resulting from bremsstrahlung from the electrons. The comparison shows the direct effect is relatively larger than is predicted by existing theories of electrodisintegration if the transitions being excited are entirely electric dipole. Agreement with the theory can be obtained if electric monopole and quadrupole transitions, are also assumed present. The theory, however, makes use of approximations which are probably not valid for nuclei with high Z. If there is a monopole resonance in the region 25-40 mev excitation, its contribution to the 2n and 3n reactions is less than 30% of the contributions of higher multipoles to these reactions. (Contractor's abstract)

2578

Stanford U. High-Energy Physics Lab., Calif.

AN EXPERIMENTAL SEARCH FOR DIPOLE STRUCTURE OF THE ELECTRON, by G. R. Burleson and H. W. Kendall. Apr. 1960 [24]p. incl. diagrs. tables, refs. (Rept. no. HEPL-191) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under N6onr-26116) Unclassified

Also published in Nuclear Phys., v. 19: 68-78, Sept. 1960.

By measuring absolute cross sections for the elastic scattering of electrons from the α particle, a determination of $\alpha(q) = [\lambda^2(q) + \mu^2(q)]^{\frac{1}{2}}$ has been found, where $\lambda(q)$ and $\mu(q)$ are structure form factors of an electric dipole moment and an anomalous magnetic dipole moment of the electron. They are functions of the four-momentum transfer q. The result is $\alpha(q) = (9.3 \pm 6) \times 10^{-5}$ $e\hbar/m_0c$ with other uncertainties of $\pm 7 \times 10^{-5}$ $e\hbar/m_0c$, for $q \leq 2.25$ (fermi)$^{-1}$. The experiment also determines the charge form factor of the α particle. The data correspond to the scattering from a Gaussian charge distribution having an rms radius of (1.68 ± 0.04) fermi. (Contractor's abstract)

2579

Stanford U. High-Energy Physics Lab., Calif.

NEUTRON FORM FACTORS FROM HIGH-ENERGY INELASTIC ELECTRON-DEUTERON SCATTERING, by S. Sobottka. [1960] [8]p. incl. diagrs. tables, refs. (Rept. no. HEPL-186) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N8onr-25116]) Unclassified

Published in Phys. Rev., v. 118: 831-838, May 1, 1960.

The inelastic electron-deuteron scattering cross section has been measured for incident electron energies between 300 mev and 650 mev and for final electron energies primarily at the maxima of the inelastic continua. The data were interpreted in terms of neutron form factors by employing the impulse approximation calculations of Goldberg. The results indicate F_{2n}^2 is nearly equal to the proton form factor F_p^2 for $2.65 < q^2 < 15.1$ (fermi)$^{-2}$ but may be 20% or 30% higher than F_p^2 for the lowest of these q values. Uncertainties, primarily in the

theory, make it possible to determine whether the difference is real. The results also indicate that $-2.5 < F_{1n}/F_{2n} < 0.5$ for $5.1 < q^2 < 12.8 f^{-2}$. (Contractor's abstract)

2580

Stanford U. High-Energy Physics Lab., Calif.

BREMSSTRAHLUNG INTENSITIES FROM HYDROGEN, by L. Becker, W. K. H. Panofsky, and H. C. DeStaebler. May 10, 1960 [3]p. incl. diagr. (Rept. no. HEPL-202) [Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commision, and Office of Naval Research under N6onr-25116] Unclassified

It is reported that plotting k N(k) against k, where N(k) dk is the probability per effective radiation length X_0 shows that an electron radiates a photon with energy k and (k + dk). The concept of radiation length is associated with bremsstrahlung for complete screening when it has 2 simple properties: (1) that k N(k) approaches 4/3 as k approaches 0; (2) that $\int k\, N(k)\, dk/k_{max} = 1$. These properties give values of radiation length of 61.2 g cm^{-2}, and 61.6 g cm^{-2}. The average of these is used for the effective radiation length in hydrogen, $X_0 = 61.4$ g cm^{-2}. The curves arrived at show a greater variation than the usual bremsstrahlung curves. It is suggested that they be used in calculations in place of the conventional radiation length.

2581

Stanford U. High-Energy Physics Lab., Calif.

ELECTROPRODUCTION OF PIONS FROM HYDROGEN AND DEUTERIUM, by G. G. Ohlsen. May 20, 1960 [34]p. incl. diagrs. tables, refs. (Rept. no. HEPL-203) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under N6onr-25116) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 71, Jan. 27, 1960.

Also published in Phys. Rev., v. 120: 584-592, Oct. 15, 1960.

The absolute cross section for direct production of pions in electron-proton and electron-deuteron collisions has been measured by the detection of inelastically scattered electrons. Proton data has been taken throughout the range of $q^2 = 2.6 f^{-2}$ to $q^2 = 10.75 f^{-2}$, and center-of-mass energy E = 1100 mev to E = 1300 mev. Data analysis has been in terms of neutron magnetic moment distribution. Comparison with available theory yields a neutron rms magnetic moment of 1 f, but better theoretical calculations may change this value somewhat. No theory for the electroproduction of pions from deuterons exists at present. The deuteron data is presented in terms of absolute cross sections as well as in terms of deuteron-proton cross section ratio. (Contractor's abstract)

2582

Stanford U. High-Energy Physics Lab., Calif.

EXPERIMENTAL STUDY OF THE MAGNETIC STRUCTURE OF THE NEUTRON, by J. I. Friedman, H. W. Kendall, and P. A. M. Gram, III. May 25, 1960 [29]p. incl. diagrs. table, refs. (Rept. no. HEPL-199) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under N6onr-25116) Unclassified

Also published in Phys. Rev., v. 120: 992-999, Nov. 1, 1960.

A measurement of the ratio of the magnetic form factor of the neutron to that of the proton has been carried out by comparing large- and small-angle elastic electron-deuteron scattering at constant four-momentum transfers. The experimental result for the average value of the ratio in the range of momentum transfers from $1.6 f^{-1}$ to $2.25 f^{-1}$ is $F_{2n}/F_p = (0.91 \pm 0.05) \pm 0.07$; the first error is a standard deviation from experimental uncertainties, and the second from theoretical uncertainties in the analysis. Measurements of the ratio of the nucleon isotopic scalar form factors have also been obtained from this experiment. The average value of F_2^s/F_1^s for the same range of momentum transfers has been found to be $(+0.06 \pm 0.09) \pm 0.13$. The small-angle scattering data have been used to determine the charge form factor of the deuteron in the range of momentum transfers from $0.98 f^{-1}$ to $2.8 f^{-1}$. The results are consistent with a repulsive-core model of the deuteron. (Contractor's abstract)

2583

Stanford U. High-Energy Physics Lab., Calif.

DOUBLE FOCUSING ZERO DISPERSION MAGNETIC SPECTROMETER, by R. A. Alvarez, K. L. Brown and others. [1960] [9]p. incl. diagrs. tables. (Rept. no. HEPL-155) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under N6onr-25116) Unclassified

Published in Rev. Scient. Instr., v. 31: 556-564, May 1960.

A double focusing zero dispersion magnetic spectrometer

has been constructed having the following properties: The spectrometer consists of two magnets, each n ≈ 0.25, 110° deflection, 30-in. radius of curvature, bending the particles in the same sense. For the central momentum p_0, the useful solid angle Ω_0 is ~ 0.0055 sr with a possibility of improvement to 0.01 sr. The momentum acceptance Δp is in excess of ± 4% with a useful solid angle Ω of ~ 0.0015 sr at the 4% points. For a point source and for the solid angles and momentum acceptances given, over 90% of the trajectories terminate within a circle of 2-in. diameter at the focal plane. (Contractor's abstract)

2584

Stanford U. High-Energy Physics Lab., Calif.

SCATTERING OF HIGH-ENERGY ELECTRONS FROM Ca^{40}, V^{51}, Co^{59}, In^{115}, $Sb^{121, 123}$ AND Bi^{209}, by H. Crannell, R. Helm and others. June 1, 1960 [24]p. incl. diagrs. tables. (Rept. no. HEPL-206) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under N6onr-25116) Unclassified

Also published in Phys. Rev., v. 121: 283-289, Jan. 1, 1961.

The absolute elastic electron-scattering cross sections of Ca^{40}, V^{51}, Co^{59}, In^{115}, $Sb^{121, 123}$, and Bi^{209} have been measured at a number of angles at a primary electron energy of 183 mev. The cross sections were obtained by comparison with scattering from the proton. These data have been compared with the previous relative angular distributions measured by Hahn, Ravenhall, and Hofstadter. The present data are in closer agreement with the charge distributions found from fitting a Fermi 2-parameter model to the older data than with those found from a fit of the Ford and Hill charge distributions. The absolute cross sections for Bi^{209} show the least agreement: they are 35% larger than the predictions of the Fermi model and about 70% larger than the Ford and Hill model. (Contractor's abstract)

2585

Stanford U. High-Energy Physics Lab., Calif.

NUCLEAR EXCITATION BY SCATTERING OF 40-MEV ELECTRONS, by W. C. Barber, F. Berthold and others. July 12, 1960 [37]p. incl. diagrs. table, refs. (Rept. no. HEPL-205) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under N6onr-25116) Unclassified

Also published in Phys. Rev., v. 120: 2081-2090, Dec. 15, 1960.

The electron energy spectra resulting from the scattering of 40-mev primary electrons were measured for the purpose of studying nuclear excitations. Targets of Li^6, Be, C, and Si were employed at scattering angles of 132° and 160°; Pb was studied at a single angle of 160°. In addition to the elastic peaks, all spectra show peaks corresponding to excitation of the target nucleus into well-defined energy states. Peaks corresponding to known levels in Li^6 at 2.18 and 3.56 mev, in Be^9 at 2.43 mev, and in C^{12} at 15.1 mev, were measured and analyzed by a virtual photon theory to give values of $(4^{+3}_{-1.5}) \times 10^{-4}$, 6.2 ± 0.6, 0.13 ± 0.03, and (40^{+8}_{-6}) ev for the values of their respective radiation widths to the ground states. Other well-defined peaks were observed at excitation energies of 16.9 mev in Be, 11.6 mev in Si, and 4.2 mev in Pb. Broad peaks corresponding to the excitation of the giant resonance were observed in C, Si, and Pb, with maxima at 23, 20, and 15 mev, respectively, and integrated cross sections of 75, 125, and 6500 mev-mb, respectively. These cross sections are uncertain by a factor of approximately two because they depend on arbitrary methods used in subtracting the continuum of low-energy electrons and on arbitrary assumptions about nuclear form factors. (Contractor's abstract)

2586

Stanford U. High-Energy Physics Lab., Calif.

ELECTRON-PROTON SCATTERING AT 900 MEV AND 135°, by L. N. Hand. [1960] [2]p. incl. diagr. tables. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25113]) Unclassified

Published in Phys. Rev. Ltrs., v. 5: 168-169, Aug. 15, 1960.

Using a liquid H_2 target at q^2 = 23.9, 25.1 and 26.7 f^{-2}, the incident electron energies obtained are 825, 856 and 896 mev. In order to keep a constant geometry, normalization was carried out by taking measurements at 45° and electron energies of 374 and 381 mev. The experimental values of F^2 (absolute cross sections) are in agreement with that of the exponential model with a = 0.80 f.

2587

Stanford U. High-Energy Physics Lab., Calif.

A MICROWAVE SEPARATOR FOR HIGH-ENERGY PARTICLE BEAMS, by P. R. Phillips. Aug. 18, 1960 [14]p. incl. diagrs. table. (Rept. no. HEPL-213) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under N6onr-25116) Unclassified

Also published in Rev. Scient. Instr., v. 32: 13-16, Jan. 1961.

The design and construction of a microwave separator for high-energy particle beams, following the original ideas of Panofsky and Wenzel are described. A TM_{012} rectangular cavity with a Q of 15,000 and a maximum power dissipation of 1.3 megawatts was used. Thus it could deflect electrons of 150 mev/c momentum through 3/4 in. at the final focus of the analyzing magnet. The available sperture is so small that the technique is not immediately useful, but it is anticipated that it may become so at higher energies, when other methods of beam separation become unfeasible. (Contractor's abstract)

2588

Stanford U. [High-Energy Physics Lab.] Calif.

A MEASUREMENT OF THE PRESENCE OF THE RETARDATION TERM IN PION PHOTOPRODUCTION USING POLARIZED X-RAYS OF 342 AND 373 MEV, by R. C. Smith and R. F. Mozley. [1960] [2]p. incl. table. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116]) Unclassified

Published in Proc. 1960 Annual Internat'l. Conf. on High-Energy Phys., Rochester, N. Y. (Aug. 25-Sept. 1, 1960), New York, Interscience Publishers, 1960, p. 22-23. (AFOSR-1646)

Measurements of meson (π^+) photoproduction were made using polarized x-rays in order to show the desirability of a retardation term in fitting the measured angular distributions. A relation was derived in which $PA = (R - 1/R + 1)\ \sigma$ unpolarized/sin 2θ) where P is polarization, σ is cross section, θ is angle of meson production, and R is the ratio of yields of positive and negative polarization.

2589

Stanford U. High-Energy Physics Lab., Calif.

REMARKS ON THE USE OF A SOLENOIDAL IRON-FREE SPECTROMETER IN HIGH-ENERGY ELECTRON PHYSICS, by R. Hofstadter, G. R. Burleson and others. [1960] [17]p. incl. diagrs. table. (Rept. no. HEPL-222) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under N6onr-25116) Unclassified

Also published in Proc. 1960 Annual Internat'l. Conf. on High-Energy Phys., Rochester, N. Y. (Aug. 25-Sept. 1, 1960), New York, Interscience Publishers, 1960, p. 316-319. (AFOSR-1646)

An iron-free solenoidal type of spectrometer is described for use in high-energy electron physics. The spectrometer is of the ellipsoidal du Mond type and focuses 500 mev/c momentum particles in a ring focus. The field employed is 20,000 gauss. A description of the instrument and its mounting in an experimental area is presented. A discussion is given of a series of experiments that can be carried out with this instrument. (Contractor's abstract)

2590

Stanford U. [High-Energy Physics Lab.] Calif.

PROGRESS REPORT ON e-e COLLIDING BEAMS EXPERIMENT, by W. K. H. Panofsky. [1960] [2]p. incl. diagr. (Rept. no. HEPL-238) [Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under N6onr-25116] Unclassified

Also published in Proc. 1960 Annual Internat'l. Conf. on High-Energy Phys., Rochester, N. Y. (Aug. 25-Sept. 1, 1960), New York, Interscience Publishers, 1960, p. 769-770. (AFOSR-1646)

A brief progress report is given of an experiment designed to overcome, by the use of colliding electron beams, the unfavorable relation that the square of the 4-momentum transfer is given by twice the rest mass of the electron times the energy transfer to the electron. The experiment is designed so that the beam from the electron accelerator will be injected with the aid of 3 bending magnets which can steer the beam into either ring. The amplitude of the radial betatron oscillation is suppressed below that of the injection amplitude by a pulsed inflector which generates a pulse 80 mμ sec long at the appropriate time. The average radiation loss of 4 kev per turn for 500 mev beam is compensated for by a rf cavity which operates at a crest voltage of 20 kv. The 2 beams are made to cross over at the intersecting part of the magnets by means of 2 magnetic fields parallel to the plane of the orbit. These fields distort the vertical equilibrium orbit in such a way that a fairly steep crossover occurs at the center of the common straight-section, which therefore defines the interaction region in the experiment.

2591

Stanford U. High-Energy Physics Lab., Calif.

ELECTRON SCATTERING FROM THE PROTON, by F. Bumiller, M. Croissiaux, and R. Hofstadter. [1960] [10]p. incl. diagrs. table. (Rept. no. HEPL-214) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116]) Unclassified

Also published in Phys. Rev. Ltrs., v. 5: 261-263, Sept. 15, 1960.

A new 180° double-focusing magnetic spectrometer with a mean radius of curvature of 72 in. was used, together with an older 36-in. spectrometer, to measure the cross-section as a function of angle for scattering of 600-900

mev electrons on protons. Čerenkov counters were used as detectors. The results obtained are tabulated and are accurate to about ± 10%.

2592

Stanford U. High-Energy Physics Lab., Calif.

SPLITTING OF THE PROTON FORM FACTORS AND DIFFRACTION IN THE PROTON, by R. Hofstadter, F. Bumiller, and M. Croissiaux. [1960] [8]p. incl. diagrs. table. (Rept. no. HEPL-215) (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116]) Unclassified

Also published in Phys. Rev. Ltrs., v. 5: 263-265, Sept. 15, 1960.

Recent studies on electron-proton scattering have extended measurements of the proton form factors (F_1,F_2) to regions of momentum transfer $9.3 < q^2 < 21.24$ where q^2 is measured in $(\text{fermis})^{-2}$. The form factors are less than unity, indicating finite structure and remain almost equal up to $q \cong 7$ when they diverge, F_1 tending to become constant at a value 0.43 and F_2 tending to zero at $q^2 \sim 24$. This tendency of F_2 indicates that the Pauli magnetic moment cloud of the proton has a spread-out distribution and the F_1 value suggests that the Dirac electron magnetic cloud has a small core. The electron-proton scattering data at 145° shows a characteristic diffraction dip similar to that observed in electron scattering studies with heavier nuclei.

2593

Stanford U. High-Energy Physics Lab., Calif.

ENHANCEMENT OF BREMSSTRAHLUNG PRODUCED BY 575-MEV ELECTRONS IN A SINGLE CRYSTAL OF SILICON, by A. N. Saxena. [1960] [2]p. incl. diagr. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116]) Unclassified

Published in Phys. Rev. Ltrs., v. 4: 311-312, Mar. 15, 1960.

An improved method has been devised of observing the expected enhancement of the bremsstrahlung produced by high-energy electrons when they pass through a single crystal. The ratio of the charges, a measure of the enhancement, was observed for various angles as the crystal was rocked back and forth about the vertical and horizontal axis. An angular grid of ± 16′ of θ_v, the rotation about the vertical axis, and about ± 48′ of θ_h, the rotation about the horizontal axis, was covered in steps of 4′.

2594

Stanford U. High-Energy Physics Lab., Calif.

INELASTIC SCATTERING OF ELECTRONS FROM He^4, by G. R. Burleson. [1960] [7]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research, Atomic Energy Commission, and Office of Naval Research under [N6onr-25116]) Unclassified

Published in Phys. Rev., v. 121: 624-630, Jan. 15, 1961.

The inelastic scattering of electrons from He^4 which corresponds to a disintegration of the nucleus has been studied for incident electron energies of 400 and 500 mev at laboratory angles from 45° to 135°. The energy spectra of the scattered electrons were measured, and absolute cross sections were found by comparison with elastic scattering from hydrogen. The curves were corrected from electron radiation. Within the validity of adapting to He^4 one of the results of the Goldberg theory of deuteron electrodisintegration, the cross sections at the maxima of the curves give a value of $M\langle 1/p\rangle_\alpha$ of (7.5 ± 1.5), where M is a nucleon mass and $\langle 1/p\rangle_\alpha$ is the expectation value of the reciprocal of the momentum of a nucleon bound in He^4. With a single exception, the energy-integrated cross sections $d\sigma_\alpha/d\Omega$ agree within experimental error with $d\sigma_\alpha/d\Omega = 2(d\sigma_p/d\Omega + d\sigma_n/d\Omega)$, where $d\sigma_p/d\Omega$ is the free-proton cross section and $d\sigma_n/d\Omega$ is the neutron cross section found from inelastic scattering from deuterium.

2595

Stanford U. Microwave Lab., Calif.

THE STATISTICAL BASIS OF HYDRODYNAMICS AND KINETIC THEORY, by L. W. Davis. Oct. 1960, 83p. incl. diagrs. refs. (ML rept. no. 755) (AFOSR-TN-60-1337) (AF 49(638)342) AD 247590 Unclassified

A formalism is developed in which problems of hydrodynamics and kinetic theory are treated as examples of statistical inference. The prediction of some quantity, such as density, appears as a decision process in which all of the available macroscopic information is incorporated, and, subject to this constraint, that decision is made which minimizes the expected square of the error. The resulting theory is mathematically similar to the Born-Green kinetic theory of fluids (Proc. Roy. Soc. (London), v. 188A: 10, 1946), but differs in important respects. The principle of maximum entropy is introduced to provide a definite mathematical procedure by which initial macroscopic information is converted into an initial probability distribution. The maximum entropy principle leads to a generalization of the usual partition functions of statistical mechanics and allows the incorporation of such macroscopic information as spatial variations of density and momentum into the equations.

The 1-molecule distribution function, which in the Born-Green theory was interpreted as giving the actual number density in position velocity space, now appears only as the expectation value of number density over a deeper probability distribution. The difference in interpretation leads to entirely different criteria for making approximations in practical calculations. It is shown that assumptions of factorized 2-particle distributions (Boltzmann equation), or of the superposition approximation, may introduce systematic errors which lead to conclusions that are not only quantitatively, but also qualitatively, wrong. (Contractor's abstract)

2596

Stanford U. Microwave Lab., Calif.

LANDAU DAMPING OF CIRCUIT AND ION WAVES, by P. A. Sturrock. Jan. 1960, 14p. incl. diagrs. (ML rept. no. 665) (AFOSR-TN-60-141) (AF 49(638)415) AD 233751; PB 146348 Unclassified

It is shown that the interaction of a slow circuit wave with the thermal electrons of a plasma column should lead to dissipation of the circuit wave by the mechanism of Landau damping. Numerical estimates indicate that this effect should be susceptible to experimental verification. Such an experiment, if successful, would offer a method for determining the electron velocity distribution of a plasma column. A circuit analogue for the ion-acoustic-wave mechanism is derived which facilitates calculation of the Landau damping of ion waves. This effect is found to be small and cannot account for the difficulty experienced in attempting to set up these waves. It is suggested that a slow-wave circuit, in combination with a plasma column, might provide a suitable technique for investigating Van-Kampen waves and ion acoustic waves. (Contractor's abstract)

2597

Stanford U. Microwave Lab., Calif.

MICROWAVE PROPERTIES OF NONSTOICHIOMETRIC POLYCRYSTALLINE YTTRIUM IRON GARNET, by P. E. Seiden, C. F. Kooi, and J. M. Katz. [1960] [6]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)415] and Lockheed Missiles and Space Division) Unclassified

Published in Jour. Appl. Phys., v. 31: 1291-1296, July 1960.

Samples ranging from 3% iron excess through stoichiometric to 12% Yt excess were studied. No ion substitution in the garnet lattice is observed. All material in excess of stoichiometric proportions goes into ceramic second phases. The phases observed are perovskite ($YFeO_3$) for Yt excess, hematite (Fe_2O_3) for Yt iron-excess samples fired in oxidizing atmospheres, and magnetic (Fe_3O_4) for iron-excess samples fired in neutral atmospheres. On the basis of the assumption that all excess material goes into the appropriate ceramic second phase, the behavior of the saturation mangetization, spectroscopic splitting factor, and line-width as a function of composition may be accounted. It is found that the line-width is strongly narrowed by the large magnetization as predicted by Geschwind and Clogston. The behavior of the dielectric constant can be explained, at least qualitatively, by a theory of Wagner and Siliars which considers particles of one dielectric material imbedded in a matrix of another. The behavior of the dielectric loss tangent is not understood and cannot be accounted for by this theory. (Contractor's abstract)

2598

Stanford U. Microwave Lab., Calif.

THEORY OF "rf CONFINEMENT" EXPERIMENTS AT LOW FREQUENCIES (Abstract), by H. S. Butler and G. S. Kino. [1960] [1]p. [AF 49(638)415] Unclassified

Presented at meeting of the Amer. Phys. Soc., Gatlinburg, Tenn., Nov. 2-5, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 6: 197, Mar. 20, 1961.

It has been observed experimentally that the application of a radio-frequency field (1 kc/sec - 10 mc/sec) to certain electrode configurations around the outside of a plasma discharge tube leads to a constriction of the light-emitting portion of the plasma away from the walls of the glass tube. The signal from a square wave generator will produce analogous results. This constriction, erroneously labeled rf confinement, is actually a high-voltage dc sheath formed by an interaction of the plasma with the rf field. A description will be given of the dependence of the interaction on the plasma density, the wall potential, and the frequency and amplitude of the rf signal. In addition, a theory will be presented which not only predicts the gross features of the interaction but also gives quantitative agreement with the experiments.

2599

Stanford U. Microwave Lab., Calif.

SMALL-SIGNAL ANALYSIS OF THE HELITRON OSCILLATOR, by R. H. Pantell. [1959] [8]p. incl. diagrs. (Sponsored jointly by Air Force [Office of Scientific Research], Office of Naval Research, and Signal Corps under [N6onr-25123]) Unclassified

Published in I.R.E. Trans. on Electron Devices, v. ED-7: 22-29, Jan. 1960.

A small-signal analysis of a microwave oscillator discussed by Watkins and Wada is presented. The helitron has an electron beam describing the trajectory of a helix between 2 concentric cylinders. Interaction is with a TEM mode supported on the inner cylinder, and

the beam is focused by having a difference between the cylinders. This has been termed an E-type tube. Results show that the electrons bunch along the direction of rotation, and lose kinetic energy. Results also show that space charge forces tend to increase the bunching along the direction of rotation which results in a negative value for the space-charge parameter, and an attendant reduction in starting current. (Contractor's abstract, modified)

2600

Stanford U. Microwave Lab., Calif.

ON THE CONCEPT OF FICTITIOUS SURFACE CHARGES OF AN ELECTRON BEAM, by E. L. Chu. [1958] [8]p. incl. refs. (Sponsored jointly by Air Force [Office of Scientific Research], Office of Naval Research, and Signal Corps under [N6onr-25123]) Unclassified

Published in Jour. Appl. Phys., v. 31: 381-388, Feb. 1960.

The electrodynamical phenomena in the boundary strip of a sharply focused electron beam are extremely complicated. This difficulty is usually resolved by postulating a layer of surface current on the boundary of the unperturbed beam while considering the troublesome boundary strip as nonexistent. A critical examination is made of this technique with the result that, if the calculated rf power is to be the same as in the actual beam, a layer of electric dipoles must be postulated also. The discussion begins with the Jacobian and Taylor's expansion, with particular emphasis on the applicability of the latter to the boundary strip, then proceeds to the formulation of a modified problem on an equal-power basis and the specification of the surface conditions which are to be satisfied. Second-order quantities are included in all equations, so that the small-signal beam can be readily calculated. (Contractor's abstract)

2601

Stanford U. Microwave Lab., Calif.

RESONANT MODES IN WAVELENGTH WINDOWS, by M. P. Forrer and E. T. Jaynes. [1959] [4]p. incl. diagrs. (Sponsored jointly by Air Force [Office of Scientific Research], Office of Naval Research, and Signal Corps under [N6onr-25123]) Unclassified

Published in I.R.E. Trans. on Microwave Theory and Techniques, v. MTT-8: 147-150, Mar. 1960.

Analysis and experimental verification of a class of resonant fields, called ghost-modes, occurring in waveguide dielectric windows are presented. Numerical solutions for a simple geometry are given through universal curves. Knowledge about ghost-modes has importance to designers of high-power windows. It also leads to a measuring technique for dielectric constants through a frequency measurement. (Contractor's abstract)

2602

Stanford U. Microwave Lab., Calif.

IN WHAT SENSE DO SLOW WAVES CARRY NEGATIVE ENERGY?, by P. A. Sturrock. [1960] [5]p. (Sponsored jointly by Air Force [Office of Scientific Research], Office of Naval Research, and Signal Corps under [N6onr-25123]) Unclassified

Published in Jour. Appl. Phys., v. 31: 2052-2056, Nov. 1960.

It has been found in the theory of electron tubes that, according to the small-amplitude power theorem, the fast and slow spacecharge waves carry positive and negative energy, respectively. Similar analysis of different systems leads to similar results, leading to the conjecture that there is some sense in which the assertion can be made, for a wide class of dynamical systems, that slow waves carry negative energy. In a 1-dimensional model, slow and fast waves in a moving propagating medium refer to waves of which the phase velocity does or does not change sign, respectively, on transforming from the moving frame to the stationary frame. Small-amplitude disturbances of any dynamical system may be described by a quadratic Lagrangian function, from which the canonical stress-tensor, elements of which are quadratic functions of the variables, can be formed. These variables appear in the linearized equations of motion. For any pure wave in this system, the energy density E and the momentum density P, as they appear in the canonical stress tensor, are related to the frequency ω and wave number k by $E = J\omega$, $P = Jk$, where $2\pi J$ is the action density. The rules for the Galilean transformation now show that the energy densities, as measured in the stationary frame, of fast and slow waves have positive and negative signs, respectively, if the energy densities of both waves are positive in the moving frame. Similar arguments explain the signs of the energy density of transverse disturbances of an electron beam in a magnetic field. (Contractor's abstract)

2603

Stanford U. Microwave Lab., Calif.

ENERGY-MOMENTUM TENSOR FOR PLANE WAVES, by P. A. Sturrock. [1960] [2]p. (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under [N6onr-25123]) Unclassified

Published in Phys. Rev., v. 121: 18-19, Jan. 1, 1961.

A general form is established for the energy momentum tensor for plane waves propagating in a homogeneous medium, the field equations of which are derivable from

a quadratic Lagrangian function. Energy density and momentum density are proportional to frequency and the wave vector, the coefficient of proportionality being "action density". Energy flow and momentum flow are related to energy density and momentum density by the group velocity. The relation between momentum density and the wave vector is valid even in a nonlinear system. For a wave packet, one finds that the total energy is related to frequency and the total momentum to the wave vector by the total action of the packet, in close analogy with corresponding relations of quantum mechanics. (Contractor's abstract)

2604

Stanford U. [Microwave Lab.] Calif.

A HIGH-EFFICIENCY KLYSTRON WITH DISTRIBUTED INTERACTION, by M. Chodorow and T. Wessel-Berg. [1960] [12]p. incl. illus. diagrs. (Sponsored jointly by Air Force [Office of Scientific Research], Office of Naval Research, and Signal Corps under [N6onr-25123]) Unclassified

Published in I.R.E. Trans. on Electron Devices, v. ED-8: 44-55, Jan. 1961.

A theoretical and experimental investigation of a special form of a 3-cavity klystron amplifier having shorted sections of a slow-wave structure as resonators is described. A higher efficiency and larger gain-bandwidth product, as predicted by theory, were observed experimentally with a pulsed S-band distributed klystron operated at maximum beam voltage of 22 kv and a beam current of 3.5 amp. Saturation efficiencies of approximately 50% at 18 db gain and 2% half-power bandwidth, and small-signal gain of 40 db at 0.5% bandwidth were measured. Small-signal behavior is in good agreement with the space-charge-wave theory. At large-signal levels, experimental results and simplified kinematic theories agree qualitatively. (Contractor's abstract)

2605

Stanford U. Microwave Lab., Calif.

GENERAL RELATIONS CONCERNING MULTIPLY-PERIODIC EXCITATION OF NONLINEAR DYNAMICAL SYSTEMS, by P. A. Sturrock. [1960] [16]p. incl. refs. [Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under N6onr-25123] Unclassified

Published in Ann. Phys., v. 15: 250-265, Aug. 1961.

If a nonlinear dynamic system is in a state of steady multiply-periodic excitation with a number of incommensurable fundamental frequencies, there exist the same number of relations governing the transfer of energy in this system. General forms for these relations may be established by modifications of the theorem of the Poincaré invariant. These theorems enable one to associate a conservation relation with a closed (cyclic) family of dynamical systems; such a family may be formed by varying any one of the phase parameters which one may associate with the fundamental frequencies. The relations are first set up in a form appropriate to systems with a finite number of degrees of freedom. When applied to a purely reactive electrical network, these relations reduce to those derived by Manley and Rowe. The relations are next established in a form appropriate to the study of nonlinear fields. The general relations are specialized for the following examples: nonlinear electromagnetic media; 1-dimensional electron beam with electrostatic field; and unrestricted electron flow with electromagnetic field. These examples reproduce and extend relations established by Haus and Grau. (Contractor's abstract)

2606

Stanford U. Microwave Lab., Calif.

BALANCED ACCELERATION AND DEFLECTION ELECTROSTATIC FOCUSING, by P. A. Sturrock. Apr. 1960, 7p. illus. (ML rept. no. 690) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22548) AD 238389 Unclassified

Also published in Jour. Electronics and Control, v. 8: 267-272, Jan.-June 1960.

Periodic focusing systems normally have the following property: as the strength of the focusing field is increased from zero, the system is initially stable but subsequently passes through alternate bands of stability and instability of which the former are normally the narrower. In consequence, operation of a given system must usually be restricted to the first band. A suitable combination of acceleration focusing and deflection focusing leads to a model for a periodic electrostatic focusing system which is free from stabilities. Convenient electrode structures are shown which will approximate the required field; the resulting system should have only narrow bands of instability. Such structures are similar to the Slalom configuration with the important difference that the beam travels on one side only of the central electrodes. This scheme also has the following characteristics which should make it suitable for incorporation in a tape-helix traveling-wave tube; the beam velocity varies in such a way that electrons spend most time between the central electrodes, and the beam thickness varies in such a way that the beam is thinnest where it passes the central electrodes. (Contractor's abstract)

2607

Stanford U. Microwave Lab., Calif.

FIELD-EMISSION CATHODE MICROWAVE DEVICES, by J. Fontana. Apr. 1960, 194p. incl. illus. tables, refs. (ML rept. no. 700) (Sponsored jointly by Air Force

Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22548) AD 236390
Unclassified

The field emission effect is discussed in relation to devices for microwave amplification and harmonic generation where the high current densities and minute dimensions of field-emission cathodes are especially desirable. The characteristics of field-emission diodes are expressed in terms of parameters dependent upon paraboloidal geometry for the emitter and collector. An application of the emission modulation properties is given in the design of a microwave 2-cavity amplifier, including the operating characteristics and expected performance. Nonlinear properties of RF emission from biased emitters subjected to RF fields is expressed by an approximate analytical procedure. The typical values obtained in the computations demonstrate possibilities for using this nonlinearity in harmonic generators at microwave and millimeter wave frequencies. Equivalent circuits are used to analyze the operation of 1-cavity and 2-cavity harmonic generators. The design and construction of a 1-cavity harmonic generator tube operating with a 3 kmc fundamental frequency are described. This tube was designed principally to study the field-emitter characteristics and to obtain quantitative measurements of the harmonic amplitudes in the emitted current. Some preliminary test results are given. (Contractor's abstract)

2608

Stanford U. Microwave Lab., Calif.

IN WHAT SENSE DO SLOW WAVES CARRY NEGATIVE ENERGY?, by P. A. Sturrock. Apr. 1960, 18p. refs. (ML rept. no. 712) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22548) AD 239423
Unclassified

Also published in Jour. Appl. Phys., v. 31: 2052-2056, Nov. 1960.

It was found in the theory of electron tubes that, according to the "small-amplitude power theorem", the fast and slow space-charge waves carry positive and negative energy, respectively. Similar analysis of different systems leads to similar results, leading one to conjecture that there is some sense in which one might assert that, for a wide class of dynamical systems, slow waves carry negative energy. In a 1-dimensional model, "slow" and "fast" waves in a moving propagating medium refer to waves of which the phase velocity does or does not change sign, respectively, on transforming the moving frame to the stationary frame. Small-amplitude disturbances of any dynamical system may be described by a quadratic Lagrangian function, from which one may form the canonical stress-tensor, elements of which are quadratic functions of the variables which appear in the linearized equations of motion. For any pure wave in this system, the energy density E and the momentum density P, as they appear in the canonical stress tensor, are related to the frequency ω and wave number k by $E = J\omega$, $P = Jk$, where $2\pi J$ is the action density. The rules for Galilean transformation now show that the energy densities, as measured inthe stationary frame, of fast and slow waves have positive and negative sign, respectively, if (as is usually the case) the energy densities of both waves are positive in the moving frame. (Contractor's abstract)

2609

Stanford U. [Microwave Lab.] Calif.

KINEMATIC ELECTRON BUNCHING BY SINUSOIDAL TRAVELLING AND STANDING WAVES IN SHORT EXTENDED INTERACTION REGIONS, by H. Golde. [1960] [18]p. incl. diagrs. tables. (Sponsored jointly by [Air Force Office of Scientific Research] Office of Naval Research, and [Signal Corps] under Nonr-22548)
Unclassified

Published in Jour. Electronics and Control, v. 9: 285-302, July-Dec. 1960.

The kinematic bunching of electron beams by sinusoidal traveling and standing waves of constant amplitude in the absence of space charge is treated on a large-signal basis, using the general theory developed by Wessel-Berg (STA.11:011, Vol. II). The theory predicts a maximum fundamental rf current of about 1.4 times the dc current for synchronous interaction. In order to check the validity of the theory, the equations of motion were integrated numerically on a high speed electronic computer; the theory agrees well with these computations, if the electric field does not exceed a certain critical value. Though the increase in fundamental rf current for non-synchronous operation over the synchronous value is not very great, the velocity spread within the beam is considerably reduced. This work also includes a calculation of beam-loading effects, which are compared with theoretical values. (Contractor's abstract)

2610

Stanford U. Radio [Propagation Lab.] Calif.

THE STANFORD MICROWAVE SPECTROHELIOGRAPH ANTENNA, A MICROSTERADIAN PENCIL-BEAM INTERFEROMETER, by R. N. Bracewell and G. Swarup. Nov. 25, 1960, 26p. incl. diagrs. tables, refs. (Scientific rept. no. 7; Stanford Radio Astronomy Inst. publ. no. 7) (AFOSR-TN-60-1240) (AF 18(603)53) AD 249516; PB 154129
Unclassified

Also published in I.R.E. Trans. on Antennas and Propagation, v. AP-9: 22-30, Jan. 1961.

A pencil-beam interferometer was constructed with multiple beams of 3.1 min of arc width to half power (0.8 microsteradians). It is composed of 2 equatorially-mounted, 16-element, Christiansen arrays of 3-m paraboloids, each 375 ft long (1339 wavelengths at a

wavelength of 9.1 cm). The half-power beamwidth of the fan beam of a single array is 2.3 min of arc. To form the pencil beam, the 2 arrays are switched together as in a Mills cross. Frequency range is from 2700 to 3350 mc. Phase adjustment and monitoring are handled by a new technique of modulated, weakly reflecting gas-discharges maintained at the focus of the paraboloids. Television-type scanning yields maps of the sun (spectroheliograms) revealing fine details of the microwave source regions in the chromosphere and corona. All the transient bursts and a large fraction of the steady solar emission at 9.1 cm prove to originate in a small number of highly compact centers. The sensitivity of the instrument also allows the thermal emission from the moon (250°K) and a number of galactic and extragalactic sources to be studied with high angular resolution. (Contractor's abstract)

2611

Stanford U. Radio [Propagation Lab.] Calif.

TOLERANCE THEORY OF LARGE ANTENNAS, by R. N. Bracewell. [1960] 28p. incl. illus. (Scientific rept. no. 5; Stanford Radio Astronomy Inst. publ. no. 5) (AFOSR-TN-60-1408) (AF 18(603)53) AD 249514; PB 154125 Unclassified

Also published in I.R.E. Trans. on Antennas and Propagation, v. AP-9: 49-58, Jan. 1961.

The design of an antenna calls for definite amplitudes and phases of the currents but when the antenna has been constructed and adjusted there will be departures from the design currents due to several causes. It is therefore desirable that the theory of antenna tolerances be pursued. The effects are presented of systematic and random errors on the radiation pattern of antennas representable by a field distribution over an aperture, such as paraboloidal reflectors and large arrays of small elements. In the case of paraboloids, the deterioration in directivity is found to depend on the mean square departure of the surface from the paraboloid of best weighted least-squares fit and on the 2-dimensional autocorrelation function of the departure. The variation of directivity with wavelength of a particular paraboloid is deduced by leaving out of account those 2-dimensional Fourier components of the departure with spatial periods less than a wavelength. Practical steps are considered for unifying testing, adjusting and design so as to lead to the greatest relaxation of the mechanical tolerances imposed on construction. (Contractor's abstract)

2612

Stanford U. [Radio Propagation Lab.] Calif.

MONITORING PARABOLOIDAL REFLECTOR ANTENNAS, by G. Swarup and K. S. Yang. Nov. 21, 1960, 2p. (Scientific rept. no. 3; Stanford Radio Astronomy Inst. publ. no. 3) (AFOSR-TN-60-1409) (AF 18(603)53) AD 249512; PB 154126 Unclassified

Presented at URSI-IRE joint meeting, National Bureau of Standards, Washington, D. C., May 2-5, 1960.

Also published in Proc. Inst. Radio Engineers, v. 48: 1918-1919, Nov. 1960.

A null technique is devised for monitoring paraboloid reflector antennas. A 10-mw S-band signal generator was connected to a 3 x 4 in. horn pointing in the direction of a midget 4-w standard fluorescent tube placed at a distance of 100 ft. The modulated echo was mixed with a strong local c-w signal whose phase was adjusted to obtain a null in a coherent detection system. With an echo strength of -130 dbm, it was possible to measure displacements of the tube with an accuracy of ± 0.1 in.

2613

Stanford U. Radio [Propagation Lab.] Calif.

PHASE ADJUSTMENT OF LARGE ANTENNAS, by G. Swarup and K. S. Yang. Nov. 21, 1960, 24p. incl. illus. diagrs. refs. (Scientific rept. no. 6; Stanford Radio Astronomy Inst. publ. no. 6) (AFOSR-TN-60-1410) (AF 18(603)53) AD 249515; PB 154127 Unclassified

Also published in I.R.E. Trans. on Antennas and Propagation, v. AP-9: 75-81, Jan. 1961.

A technique is described for adjustment of phase paths within large antenna arrays or paraboloidal surfaces which are now in use, or are planned, for radio astronomy. A new suggestion, is to place modulated gas discharge tubes, acting as scatterers, at various points on the paraboloidal surface and to monitor the phase path from a signal generator through the feed at the focus to each discharge tube in turn, and back. By means of a second probe, say a dipole situated at the vertex of the paraboloid, it is possible to triangulate on deflections. The feasibility of this scheme has been established in connection with the large Stanford cross antenna which has an aperture of 1339 wavelengths at 9.1 cm. The phase of the modulated reflected wave produced by the discharge tube is determined by adding it to a reference c-w wave of large amplitude and applying the resultant to a receiver sensitive to the modulating frequency. A null is obtained when the 2 waves are in quadrature. The coherent detection system allows measurement of the phase of the modulated reflection even when its amplitude is below -130 dbm. (Contractor's abstract)

2614

Stanford U. Radio [Propagation Lab.] Calif.

INTERFEROMETRY AND THE SPECTRAL SENSITIVITY ISLAND DIAGRAM, by R. N. Bracewell. Nov. 21, 1960,

28p. incl. illus. diagrs. refs. (Scientific rept. no. 4; Stanford Radio Astronomy Inst. publ. no. 4) (AFOSR-TN-60-1415) (AF 18(603)53) AD 249513; PB 154128 Unclassified

Also published in I.R.E. Trans. on Antennas and Propagation, v. AP-9: 59-67, Jan. 1961.

Basic principles of radio interferometry are expounded and a certain special diagram is established which helps with problems on interferometers, especially those with phase switching or other complications. The information on a record, or interferogram, made by scanning a compact source or target with an interferometer comprising an antenna with 2 well spaced parts, is all in 1 complex number, the complex visibility of the interference fringes. Under appropriate conditions the complex visibility observed is equal to the complex coherence, of the field produced by the source, between the points occupied by the 2 elements of the interferometer. (If the elements are not infinitesimal in extent, the complex visibility is equal instead to a weighted mean of the values of complex coherence between the pairs of points embraced by the elements.) Furthermore, this quantity gives the strength of 1 spatial Fourier component of the source distribution, in amplitude and phase. To know all Fourier components would require the use of all spacings—in 2 dimensions this means all vector spacings. Measurements at a finite number of spacings yield the principal solution; if the source is finite in extent only certain discrete spacings need be used. (Contractor's abstract)

2615

Stanford U. Radio Propagation Lab., Calif.

STANFORD MICROWAVE SPECTROHELIOGRAMS FOR 1960 APRIL, by G. Swarup. Dec. 15, 1960, 26p. incl. illus. diagrs. (Scientific rept. no. 8; Stanford Radio Astronomy Inst. publ. no. 8) (AFOSR-TN-60-1491) (AF 18(603)53) AD 249517; PB 154130 Unclassified

Maps of the sun are given showing the disc distribution of solar radio emission at a wavelength of 9.1 cm by means of radioisotopes, or lines of constant brightness temperature. The contour interval, which varies from map to map, is usually about 80,000°K and is determined after the map is drawn by reference to the measured flux density of the whole sun. A circle shows the photosphere; a correction was applied for the variation of the sun's semi-diam, so that the photospheric circle is reproduced with a constant diam of 15 cm. This scale and the orientation (north end of rotation axis at top, east on left) are in accordance with the convention adopted at the tenth general assembly of the International Astronomical Union in 1958, for the purpose of facilitating comparisons of solar data. (Contractor's abstract)

2616

Stanford U. [Radio Propagation Lab.] Calif.

A WIDE BAND SINGLE DIODE PARAMETRIC AMPLIFIER USING FILTER TECHNIQUES, by A. G. Little. Dec. 30, 1960, 8p. incl. illus. (Scientific rept. no. 9; Stanford Radio Astronomy Inst. publ. no. 9) (AFOSR-31) (AF 18(603)53) AD 250728; PB 154369 Unclassified

Also published in Proc. Inst. Radio Engineers, v. 49: 821-822, Apr. 1961.

The Stanford Radio Spectroheliograph is potentially a valuable instrument for studies of cosmic radio sources as well as of the sun but, at the moment, the sensitivity is not wholly adequate for signals of cosmic origin. To improve the sensitivity it is necessary to increase the bandwidth as well as to decrease the noise figure, and for this purpose a parametric amplifier has been developed. This amplifier uses filter techniques to achieve a broad band, and has provided 200 mc bandwidth at 3.3 kmc, with a gain of 16 1/2 db and a noise figure of 1.8 db. (Contractor's abstract)

2617

Stanford U. Radio Propagation Lab., Calif.

FAINT SIGNAL LIMITATIONS OF RADIOMETERS, by R. S. Colvin. [1959] [7]p. incl. diagrs. (AFOSR-J291) (AF 18(603)53) Unclassified

Presented at Western Electronic Show and Convention, San Francisco, Calif., Aug. 18-21, 1959.

Also published in I.R.E. WESCON Convention Record, Pt. 8, p. 52-58, 1959.

A radiometer is reduced to its essential elements and analyzed in order to focus attention on the fundamental parameters. There results an expression for minimum perceptible signal involving a bandwidth Δf, defined in terms of the self-convolution of the reception filter power transfer characteristic, and an integrating time τ, defined in terms of the equivalent width of the power transfer characteristic of the smoothing filter. Tables giving values of Δf and τ for representative filters are presented. The equivalent width definition for the bandwidth Δf is shown to be applicable to narrow power transfer characteristics of arbitrary shape which are difficult to evaluate with usual bandwidth concepts. These results apply to measurements of the strength of sources characterized as random processes whose sample functions have Gaussian amplitude distributions with zero mean value. (Contractor's abstract)

2618

Stanford U. Radio Propagation Lab., Calif.

ANTENNA TOLERANCE THEORY, by R. N. Bracewell.

[1960] [5]p. (AFOSR-J292) (AF 18(603)53)
AD 408019 Unclassified

Also published in Statistical Methods in Radio Wave Propagation; Proc. of a Symposium, California U., Los Angeles (June 18-20, 1958), New York, Pergamon Press, 1960, p. 179-183.

This paper considers the effects of systematic and random errors on the radiation pattern of antennas representable by a field distribution over an aperture, such as paraboloidal reflectors and large arrays of small elements. It is pointed out that the customary procedure of taking radiation patterns and making final adjustments semi-empirically has usually been satisfactory but that two difficulties have been setting in with the trend towards large antennas of high gain. First, it is impossible to measure the radiation pattern of the largest existing antennas, even the determination of single sections through the pattern or the gain in one direction presenting difficulty. Secondly, the adjustments are more laborious on larger antennas. In the case of paraboloids, the deterioration in directivity is found to depend upon the mean square departure of the surface from the paraboloid of best weighted least-square fit on the 2-dimensional auto-correlation function of the departure. The variation of directivity with wavelength of a particular paraboloid is deduced by leaving out of account those 2-dimensional Fourier components of the departure with spacial periods less than a wavelength. Practical steps are considered for unifying testing, adjustment and design so as to lead to the greatest relaxation of the mechanical tolerances imposed on construction. (Contractor's abstract, modified)

2619

Stanford U. Radio Propagation Lab., Calif.

PRELIMINARY OBSERVATIONS WITH THE STANFORD MICROWAVE INTERFEROMETER, by D. D. Cudaback. [1959] [3]p. incl. diagr. (AFOSR-J293) (AF 18(603)53) AD 408021 Unclassified

Presented at meeting of the Astronomical Soc. of the Pacific, San Francisco, Calif., June 1959.

The microwave interferometer was designed primarily for the observation of solar activity. At a wavelength range of 9 to 11 cm, the sun is the brightest celestial object and also has a moderate angular size. This allows it to be observed with multiple antenna beams pointing in different directions without problems from confusion. The Christiansen interferometer consists of 2 variably blazed diffraction gratings oriented along east-west and north-south lines and intersecting at their midpoints. Each grating is an array of 16 ten-ft equatorially mounted paraboloids spaced 25 ft apart. The east-west grating is used alone for patrol observations of the sun. As the sun moves across the sky it passes through fringes of successive order about every 3 min. To achieve 2-dimensional resolution, the interference patterns of both gratings are multiplied together by appropriate addition and subtraction of the waves from the 2 gratings. Observations have been made of the moon, Cassiopeia A, Cygnus A, and Taurus A, and programs are being planned for physical studies of them.

2620

Stanford U. [Radio Propagation Lab.] Calif.

BRIGHTNESS DISTRIBUTION ACROSS THE SUN AT A WAVELENGTH OF 9.1 CM (Abstract), by G. Swarup. [1960] [1]p. (AF 18(603)53) Unclassified

Presented at URSI-IRE joint meeting, National Bureau of Standards, Washington, D. C., May 2-5, 1960.

A cross antenna was constructed for observation of the sun at a wavelength of 9.1 cm. The antenna consists of 32 10-ft diam paraboloid antennas which are arranged in the form of a cross. The pencil beams of the antenna have a half-power width of about 3.5 min of arc. The beams of the antenna scan the solar disc in a television fashion to provide pictures of 2-dimensional brightness distribution across the solar disc at a wavelength of 9.1 cm. The radio pictures provide information about the localized bright regions on the solar disc. The bright regions are the ones which give rise to the slowly varying component of solar radiation, and their characteristics, such as size, temperature and height above the photosphere are described.

2621

Stanford U. [Stanford Electronics Labs.] Calif.

HYBRID WHISTLERS AND THE PROBLEM OF THE WHISTLER PATHS, by R. A. Helliwell. [1959] [10]p. incl. diagrs. (AF 18(603)126) Unclassified

Published in The Upper Atmosphere above F2-Maximum; Fourth Symposium of the Ionospheric Research Committee AGARD Avionics Panel, Paris (France) (May 26-28, 1959) [Paris], North Atlantic Treaty Organization, Advisory Group for Aeronautical Research and Development, May 1959, p. 323-332. (AGARDograph no. 42)

Whistlers frequently exhibit many well-defined components which are thought to result from the existence of separate paths of propagation. It has been suggested that such paths might be defined by columns of enhanced ionization which are aligned with the earth's magnetic field and which reach from one hemisphere to the other. Another possibility is that whistler energy is permitted to emerge from the ionosphere only at specific locations where conditions are favorable. A test to differentiate these 2 models would be to excite whistler paths simultaneously in opposite hemispheres from the same source. At a receiver in either hemisphere the result would be the superposition of long and short whistlers—a hybrid whistler. The dispersion ratios of a hybrid whistler and its echoes would be 1:2:3:4:5 etc. if the paths were the same for both directions of propagation. A search

of records from the IGY Whistler-West project revealed several examples of what appear to be genuine hybrids. Their existence argues strongly for the field-aligned column hypothesis of whistler paths. The application of this hypothesis to the calculations of electron density in the outer ionosphere is discussed. (Contractor's abstract)

2622

Stanford U. [Stanford Electronics Labs.] Calif.

COMPUTATION OF WHISTLER RAY PATHS, by L. [W.] Yabroff. Final letter rept. - Part II. Dec. 1959, 47p. incl. diagrs. (AFOSR-TN-60-71) (In cooperation with Stanford Research Inst., Menlo Park, Calif.) (AF 18(603)126) AD 233130; PB 145865 Unclassified

Also published in Jour. Research Nat'l. Bur. Stand., v. 65D: 485-505, Oct. 1961.

The mechanics and physics of electromagnetic wave propagation in an inhomogeneous, anisotropic medium is developed to analyze VLF wave phenomena in the ionosphere and outer atmosphere. Some of the complex phenomena of "magneto-ionic duct" propagation originally described by Storey in 1953, are demonstrated. A preliminary set of computations provides details of the propagation mode. Equations in spherical coordinates r, θ, φ for computation of ray paths in the ionosphere are obtained from substitution of the familiar Appleton-Hartree expression for the complex refracture index into ray equations derived by Haselgrove.

2623

Stanford U. [Stanford Electronics Lab.] Calif.

THE THEORY OF PROPAGATION OF RAYS IN AN INHOMOGENEOUS AND ANISOTROPIC MEDIUM, by J. J. Brandstatter. Final letter rept. - Part I. Dec. 1959, 62p. incl. diagrs. (AFOSR-TN-60-138) (In cooperation with Stanford Research Inst., Menlo Park, Calif.) (AF 18(603)126) AD 233108; PB 145864 Unclassified

An exposition of the background theory describing ray behavior in an inhomogeneous and anisotropic medium as a geometrized expansion of Haselgrove's paper is presented. The theory is generalized to include absorption and a method is given for measuring the dispersion of the rays based on the notion of geodesic deviation. The scope of the theory is extended by a tensor calculus derivation of the ray-path equations for a general curvilinear coordinate system. Although the method of calculating ionospheric ray paths is in a form suitable for integration by standard numerical methods, the theory development may serve in the investigation of ray tracing in ionized plasmas.

2624

Stanford U. Stanford Electronics Labs., Calif.

A THEORY OF TRAPPING OF WHISTLERS IN FIELD-ALIGNED COLUMNS OF ENHANCED IONIZATION, by R. L. Smith, R. A. Helliwell, and I. W. Yabroff. Dec. 31, 1959, 19p. incl. diagrs. table, refs. (Technical rept. no. 3) (AFOSR-TN-60-139) (AF 18(603)126) AD 233813; PB 146359 Unclassified

Presented at URSI-IRE joint meeting, Washington, D. C., May 1959.

Also published in Jour. Geophys. Research, v. 65: 815-823, Mar. 1960.

A ray theory of whistler propagation in ducts is developed for the purpose of explaining discrete whistler components. By use of refractive index surfaces and a Snell's Law construction, it is shown that the only feature of the electron distribution affecting the trapping conditions is the ratio of the electron density in the column to that of the background. In most practical cases the electron density in the column required for trapping must be greater than the background level. However, under certain conditions the density in the column must be less than the background level. Using the theory, it is found that the enhancement required for trapping increases markedly toward the equator, providing a possible explanation for reduced whistler occurrence at the lower latitudes. (Contractor's abstract)

2625

Stanford U. Stanford Electronics Labs., Calif.

A NEW MECHANISM FOR ACCELERATING ELECTRONS IN THE OUTER IONOSPHERE, by R. A. Helliwell and T. F. Bell. Feb. 23, 1960, 8p. (Technical rept. no. 4) (AFOSR-TN-60-151) (AF 18(603)126) AD 234472; PB 147336 Unclassified

Also published in Jour. Geophys. Research, v. 65: 1839-1842, June 1960.

The phenomena of high energy trapped particles are studied in the earth's outer ionosphere using a new device for particle acceleration, the geocyclotron. Through this device, trapped electrons in the outer ionosphere can be accelerated to high energy utilizing circularly polarized radiation, traveling in the whistler-mode, and the inherent phase stability of the particle-wave interaction. It is shown that this interaction is roughly analogous to the well-known synchrotron interaction. Implications of the theory are discussed and experiments are suggested which might lead to important new information concerning the behavior of particles trapped in the earth's magnetic field. (Contractor's abstract)

2626

Stanford U. Stanford Electronics Labs., Calif.

IDENTIFICATION OF WHISTLER SOURCES ON VISUAL RECORDS AND A METHOD OF ROUTINE WHISTLER ANALYSIS, by D. L. Carpenter. Mar. 15, 1960, 48p. incl. illus. diagrs. (Technical rept. no. 5) (AFOSR-TN-60-315) (AF 18(603)126) AD 235426; PB 149069 Unclassified

Two of the problems that arise in whistler analysis are discussed. These are the identification of the causative sferic associated with a whistler, and routine analysis of whistlers based on visual frequency-versus-time records (Sonograms). A brief description is given of the nature of whistlers and the type of record used in their analysis. The principal methods of identifying causative sferics on whistler records are reported. A technique is presented which involves the measurement of the delay between successive echoes of an echo train and using this delay to predict the time of the causative sferic. An abbreviated form of routine analysis is presented for application to whistlers for which the causative sferics cannot be identified. (Contractor's abstract)

2627

Stanford U. Stanford Electronics Labs., Calif.

THE USE OF NOSE WHISTLERS IN THE STUDY OF THE OUTER IONOSPHERE, by R. L. Smith. July 11, 1960, 121p. incl. diagrs. tables, refs. (Technical rept. no. 6) (AFOSR-TN-60-861) (AF 18(603)126) AD 240305; PB 149752 Unclassified

Spectrographic analysis of whistlers and nose whistlers often reveals a number of pure isolated components which have a common source. Examination of whistler data and a new theory of the propagation path lead to the conclusion that each component represents energy from the lightning source which has been trapped in a field-aligned column of enhanced ionization in the outer atmosphere. The data indicate that the lifetime of these columns is a few hours. The theory suggests that enhancements of about 5% are sufficient to explain the observed whistlers. The theory further indicates that the average group velocity of energy trapped in a column can be closely approximated by assuming that the energy travels along the maximum of ionization in the column with wave normals aligned with the magnetic field. The frequency of minimum time delay, called the nose frequency, indicates the location of the field line path. The minimum time delay gives a measure of the ionization density in the region at the top of the path. Examination of nose whistlers from a number of stations leads to a model of electron density in the outer ionosphere. The data also show an annual variation of 2:1 in the ionization density during sunspot maximum. (Contractor's abstract)

2628

Stanford U. Stanford Electronics Labs., Calif.

TRAVELING-WAVE AMPLIFICATION OF WHISTLERS, by N. M. Brice. Aug. 16, 1960, 5p. incl. diagrs. (Technical rept. no. 7) (AFOSR-TN-60-931) (AF 18(603)128) AD 243601 Unclassified

Also published in Jour. Geophys. Research, v. 65: 3840-3842, Nov. 1960.

Assuming that the traveling wave amplification mechanism is operative in the outer ionosphere, it is shown that amplification and absorption of audio frequency waves depend on their rate of change of frequency with time. For a descending gliding tone, as in a whistler, there is inherent in its propagation a bias in favor of amplification of the wave. (Contractor's abstract)

2629

Stanford U. Stanford [Electronics] Labs., Calif.

ELECTRON DENSITIES TO FIVE EARTH RADII DEDUCED FROM NOSE WHISTLERS (Abstract), by R. L. Smith and R. A. Helliwell. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)126 and Office of Naval Research under Nonr 22527) Unclassified

Presented at URSI-IRE joint meeting, National Bureau of Standards, Washington, D. C., May 2-5, 1960.

Nose whistlers obtained at various latitudes in both hemispheres over a period of years are analyzed to obtain the delay of the nose with respect to the originating atmosphere. The frequency of the nose is found to vary in a simple way with nose time delay. When the frequency-time data from trains of nose whistlers are plotted on log-log paper, the slopes for all trains are found to be virtually the same. This is interpreted to mean that the law of electron density variation with height in the outer ionosphere is fixed. The results are compared with 2 postulated models, one introduced by Dungey ($f_0 = e^{1.25/R}$) and the other by Storey ($f_0 = f_H^{1/2}$), where f_0 is the plasma frequency, f_H the gyro-frequency and R the distance from the center of the earth in earth radii. The results are clearly not in agreement with the Dungey model, but are consistent with the Storey model. By adjusting the scale factor for the latter model for a best fit to the available data, and including the effect of the F_2 layer, the distribution is given by $f_0 = 1200\ f_H^{1/2}$, f_0 and f_H in cps. The causes of the variations about the average have not been identified, but there is some evidence suggesting seasonal and solar cycle factors.

2630

Stanford U. Stanford [Electronics] Labs., Calif.

MAGNETO-IONIC DUCT OBSERVATIONS (Abstract), by R. A. Helliwell. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 18-(603)126 and Office of Naval Research under Nonr - 22527) Unclassified

Presented at URSI-IRE joint meeting, National Bureau of Standards, Washington, D. C., May 2-5, 1960.

New observations of magneto-ionic duct, or whistler-mode, signals from station NSS on 15.5 kc are reported. Simultaneous recordings at Byrd Station, Antarctica, and Greenbank, W. Va., show that the northern hemisphere echo delays are not twice those from the southern hemisphere. Quantitative comparison of these results with Cape Horn NSS data and extensive whistler data support the interpretation that the observed time delay depends on the location of the receiver and that the Greenbank echoes are 2-hop mode and not hybrids. Echo intensities are compared with theoretical calculations of whistler-mode attenuation.

2631

Stanford U. [Stanford Electronics Labs.] Calif.

ELECTRON DENSITIES TO 5 EARTH RADII DEDUCED FROM NOSE WHISTLERS, by R. L. Smith and R. A. Helliwell. [1960] [1]p. incl. diagr. (AF 18(603)-126) Unclassified

Presented at Symposium on the Exosphere and Upper F Region, Washington, D. C., May 4, 1960.

Published in Jour. Geophys. Research, v. 65: 2583, Sept. 1960.

Whistlers appear to propagate in columns of enhanced ionization aligned with the earth's magnetic field. From nose whistlers a value of 100 electrons/cm^3 is calculated at 5 earth radii. (Contractor's abstract)

2632

Stanford U. Stanford Electronics Labs., Calif.

ALUMINO-SILICATE GLASS-TO-MOLYBDENUM-[COAXIAL] SEAL, by J. F. Margiotta. Feb. 4, 1960, 11p. incl. illus. (Bull. no. 103) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 234516 Unclassified

This bulletin describes a technique for the fabrication of a coaxial seal between molybdenum and an alumino-silicate glass (Corning no. 1720). The materials used in this seal are advantageous because they are non-magnetic and will withstand a subsequent brazing temperature of 780°C and bakeout temperature of 700°C. These particular seals were used as r-f connections in a traveling-wave tube. It was found necessary to maintain a minimum wall thickness of 0.017 in. for this size (0.187 in.) molybdenum outer conductor in order to eliminate the frequent development of leaky lateral cracks in molybdenum tubing of lesser wall thickness. It was also found necessary to examine with a microscope the inside of the molybdenum outer conductor around the area to be sealed and to reject all parts that showed evidence of having lateral striations. This was done to prevent leaking at the glass-to-metal interface of the seals. The coaxial seals withstood subsequent furnace brazing (at 779°C) into a molybdenum-traveling-wave-tube envelope, using silver-copper eutectic solder. Corning no. 1723 glass may be substituted for Corning no. 1720 glass without changes in techniques or temperatures. (Contractor's abstract)

2633

Stanford U. Stanford Electronics Labs., Calif.

A PARTIAL ORDERING FOR BINARY CHANNELS, by N. M. Abramson. Apr. 15, 1960, 38p. incl. illus. table. (Technical rept. no. 2001-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 237640 Unclassified

The properties of iterated binary channels are investigated. An ordering (defined by the symbol $\supset$) of communication channels with 2 possible inputs and any number of possible outputs is defined. For any 2 such channels C_1 and C_2, this ordering has the property that if $C_1 \supset C_2$, the min average loss when using C_1 will be less than the min average loss using C_2 independent of the losses assigned to the various errors, and independent of the statistics of the source. This ordering is applied to: (a) the general binary channel, (b) the iterated binary symmetric channel, and (c) the unreliable binary symmetric channel when used with many iterations. Curves allowing one to use the ordering are given and an example using these curves is worked out. (Contractor's abstract)

2634

Stanford U. Stanford Electronics Labs., Calif.

ACTIVE NETWORKS, PAST, PRESENT AND FUTURE, by J. G. Linvill. [May 10, 1960] [8]p. incl. diagrs. (Technical rept. no. 1507-1) (Sponsored jointly by [Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps] under Nonr-22524) AD 238165 Unclassified

Also published in Active Networks and Feedback Systems, Proc. of the Symposium, New York, N. Y. (Apr. 19-21, 1960), Brooklyn, Polytechnic Press, v. 10: 18-28, 1961. (AFOSR-718)

A history of active networks is presented beginning with the synthesis of passive networks in the Thirties. During the Forties, a full-scale development of the feedback system was realized. During this period the problem of realization of low-drift structures in the presence of drifting elements was attacked. During the Fifties, active networks and feedback systems received a further impetus with the advent of the transistor. The potentialities of this area were discussed, particularly in relation to the integration of feedback systems with the circuit.

2635

Stanford U. Stanford Electronics Labs., Calif.

STATISTICAL ANALYSIS OF AMPLITUDE-QUANTIZED SAMPLED-DATA SYSTEMS, by B. Widrow. May 10, 1960, 57p. incl. illus. table, refs. (Technical rept. no. 2103-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 239776 Unclassified

The statistical theory of amplitude quantization is discussed, including first- and second-order probability density distribution of a quantizer output, first- and second-order probability density of the quantization noise, satisfaction of the quantizing theorem, and quantization of the Gaussian signals. The section on systems applications includes discussions of Sheppard's corrections for grouping, interpolation of the first-order distribution density from the histogram, recovery of autocorrelation function from roughly quantized process samples, an analysis of quantized sampled-data feedback systems, and linearization of quantized feedback systems by injection of external dither.

2636

Stanford U. Stanford Electronics Labs., Calif.

APPLICATION OF THE MAGNETORESISTANCE EFFECT TO ANALOG MULTIPLICATION, by J. M. Hunt. May 25, 1960, 119p. incl. illus. tables. (Technical rept. no. 1504-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 239978 Unclassified

Bounds on the performance of a magnetoresistance are studied. Emphasis was placed upon the following area (1) analysis of multiplier error in terms of constituent errors, (2) theoretical analysis of the source of certain errors caused by imperfections in the paired magnetoresistor unit which is the novel element of the multiplier, and (3) fabrication and test of sufficient magnetoresistor elements to permit the establishment of a realistic bound on the error component contributed by these elements. Attention also was devoted to methods for minimizing multiplier errors without recourse to external corrective circuitry. (Contractor's abstract)

2637

Stanford U. Stanford Electronics Labs., Calif.

INVESTIGATIONS OF NOISE REDUCTION IN ELECTRON BEAMS BY MEANS OF LOW-POTENTIAL REGIONS, by A. W. Shaw. May 25, 1960, 99p. incl. illus. tables, refs. (Technical rept. no. 401-2) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 238109 Unclassified

This research has been concerned with a mechanism of noise reduction in traveling-wave and backward-wave tubes. The noise-reduction comes about when an electron beam is passed through a low-potential region of the appropriate shape directly in front of the cathode. An analysis of a beam drifting at a low potential, and an experimental x-band tube in which a noise figure of 4.5 db was obtained, are both discussed. The analysis uses the density-function method. (Contractor's abstract)

2638

Stanford U. Stanford Electronics Labs., Calif.

ERROR-CORRECTING CODES FROM LINEAR SEQUENTIAL CIRCUITS, by N. M. Abramson. June 13, 1960, 20p. incl. diagrs. table, refs. (Technical rept. no. 2002-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 239777 Unclassified

Also published in Information Theory; Fourth London Symposium, Royal Inst., London (Gt. Brit.) (Aug. 29-Sept. 2, 1960), London, Butterworths, 1961, p. 26-40.

A tutorial exposition of the theory of binary error correcting codes is presented in terms of matrices which may be related to linear binary circuits. The second part shows how this approach may be used to relate several different classes of codes. The properties of optimum codes are discussed, necessary conditions for the existence of optimum burst error correcting codes are obtained, and optimum codes are found for burst lengths of three. (Contractor's abstract, modified)

2639

Stanford U. Stanford Electronics Labs., Calif.

ADAPTIVE SWITCHING CIRCUITS, by B. Widrow and M. E. Hoff. June 20, 1960, 34p. incl. illus. refs. (Technical rept. no. 1553-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 241531 Unclassified

An adaptive pattern classification machine (called "Adaline", for adaptive linear) has been devised to illustrate adaptive behavior and artificial learning. During

a training phase, crude geometric patterns are fed to the machine by setting the toggle switches in a 4 x 4 input array. Setting another toggle switch tells the machine whether the desired output for the particular input pattern in + 1 or - 1. All input patterns are classified into 2 categories. The system learns a little from each pattern and accordingly experiences a design change. After training, the machine can be used to classify the original patterns and noisy (distorted) versions of these patterns. At present the purely mechanical adaption process is accomplished by manual potentiometer-setting. A means of automating this is being developed which makes use of multi-aperture ferromagnetic devices. Solid-state adaptive logical elements will result that should ultimately be suitable to be microminiaturized. Networks of such elements would be very effective in pattern recognition systems, information storage and retrieval-by-classification systems, and self-repairing logical and computing systems. (Contractor's abstract)

2640

Stanford U. [Stanford Electronics Labs.] Calif.

POWER GAIN AND STABILITY OF MULTISTAGE, NARROW-BAND AMPLIFIERS EMPLOYING NONUNILATERAL ELECTRON DEVICES, by M. Lim. [1959] [9]p. incl. diagrs. (Sponsored jointly by Air Force [Office of Scientific Research], Office of Naval Research, and Signal Corps under Nonr-22524) Unclassified

Published in I.R.E. Trans. on Circuit Theory, v. CT-7: 158-166, June 1960.

The functional dependence of the power gain and the stability of a multistage, narrow-band, iterative amplifier upon the external interstage network and the external passive terminations is exhibited. The optimum gain of the amplifier is a function of a design parameter γ which is directly related to the terminating conductances of the amplifier. Because of the complicated functional dependence of the gain function of the amplifier on its interstage network parameters, no explicit expression is given for the optimum gain of the amplifier as a function of γ.

2641

Stanford U. Stanford Electronics Labs., Calif.

NEURISTOR STUDIES, by H. D. Crane. July 11, 1960, 191p. incl. illus. tables, refs. (Technical rept. no. 1506-2) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 240306 Unclassified

Potentialities of the neuristor are explored for use in the construction of an electronic computer in which good conductors, or wires, are not available for carrying signals. A neuristor is defined as a device having the form of a 1-dimensional channel along which signals may flow, the signals taking the form of propagating discharges having the following properties: (1) threshold stimulability; (2) uniform velocity of propagation; (3) attenuationless propagation; and (4) refractory period following the passage of a discharge, after which the neuristor can again support a discharge. Two devices are cited as members of this class: the common chemical fuse, and the axon process (nerve fiber) of a neuron. An investigation is presented of the logical power and development of specific techniques of logic realization using neuristors. To develop neuristor networks the allowed modes of interconnection of such devices must be specified. Two basic types of junctions are indicated: a T junction and an S junction. All network synthesis is then a game on these 2 (junction) symbols. The game and logical possibilities are studied in detail. It is shown that, in addition to realizing all of the conventional logic network properties with neuristors, properties not having simple direct analogs may also be realized. Two properties of importance are: (1) the ability to realize any nonplanar logic network on a 2-dimensional physical structure, and (2) the ability to obtain controllable probabilistic gate structures with exactly the same basic neuristor device.

2642

Stanford U. Stanford Electronics Labs., Calif.

ADAPTIVE SAMPLED-DATA SYSTEMS, by B. Widrow. July 15, 1960, 41p. incl. refs. (Technical rept. no. 2104-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 243265 Unclassified

An adaptive sampled-data system model that is quasi-statically linear and makes use of performance feedback for self-optimization is evaluated. The goal of adaptation is to minimize a mean-square error. Analytical results derived from the model show that misadjustments are inversely proportional to adaptation rates. Adaptation taking place at different administrative levels within the same system may be treated analytically as separate phenomena because of the great disparities in the averaging times. The adaptive model and the analytical results comprise a small-signal linear theory of adaptation. As such, this theory will find application in describing a wide class of adaptive processes when these processes are near to being optimized. (Contractor's abstract, modified)

2643

Stanford U. Stanford Electronics Labs., Calif.

A PROPOSED SYSTEM OF REDUNDANCY TO IMPROVE THE RELIABILITY OF DIGITAL COMPUTERS, by W. H. Pierce. July 29, 1960, 56p. incl. illus. (Technical rept. no. 1552-1) (Sponsored jointly by Air Force

Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 241645 Unclassified

The use of redundancy to improve reliability of digital systems is investigated for cases in which the redundancy is the simultaneous calculation of a digit by parallel devices. The purpose of the investigation is primarily to develop a systems theory for the use of mass produced assemblies of microelectronics elements for digital computers. The results are general, however, and suitable for some types of redundancy in communications systems. Binary systems which use a decision procedure of the optimum type, or near optimum systems of the same configuration but different weights, are analyzed assuming statistical independence of errors. The use of decision elements, which carry out the decision in real time, is proposed on low levels of organization, and error in these elements can be tolerated. A design procedure for using multiplexing is given. The inherent practicality of multiplexing is demonstrated by an appendix giving circuit implementations of the proposed decision element. (Contractor's abstract)

2644

Stanford U. Stanford Electronics Labs., Calif.

TRIGGERING OF AVALANCHE TRANSISTOR PULSE CIRCUITS, by R. B. Seeds. Aug. 5, 1960, 91p. incl. illus. tables. (Technical rept. no. 1653-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 246642 Unclassified

A new method is described of triggering avalanche transistor pulse circuits which is called "collector" triggering and which meets the requirement of having associated delays of only a few mμsec. A quantitative theory is developed which gives the optimum biasing conditions for these circuits and which is able to predict with a fair amount of accuracy the delays to be expected for a specific form of collector triggering. The theory is then qualitatively extended to show that in more practical collector triggering circuits comparably short delays should also be expected. Experimental measurements of actual trigger delays tend to support the theory. It is also shown that collector type triggering is applicable to circuits employing punch-through avalanche transistors or transistors wherein punch-through of the base region occurs simultaneously with avalanche multiplication. These circuits are capable of producing pulses with one or two watts of peak power density having base widths of less than one mμsec, and they exhibit trigger delays of three or four mμsec when driven with a normal amount of trigger power. (Contractor's abstract)

2645

Stanford U. Stanford Electronics Labs., Calif.

EFFECTS OF RESISTANCE IN AVALANCHE TRANSISTOR PULSE CIRCUITS, by D. J. Hamilton. [1960] [1]p. incl. diagrs. tables. (Sponsored jointly by [Air Force Office of Scientific Research], Office of Naval Research, and Signal Corps under Nonr-22524) Unclassified

Published in Proc. Inst. Radio Engineers, v. 48: 1502, Aug. 1960.

By making simplifying assumptions, expressions are obtained for the decrease in peak current and the increase in rise-time due to the series resistance R in the output circuit, where R includes both the load and the internal series resistances in the transistor. Experimental data agree satisfactorily with predictions.

2646

Stanford U. Stanford Electronics Labs., Calif.

HIGH-LEVEL INJECTION EFFECTS IN TRANSISTORS, by R. A. Manhart. Sept. 9, 1960, 117p. incl. illus. tables, refs. (Technical rept. no. 1751-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 246641 Unclassified

A theoretical analysis of the 1-dimensional diffusion transistor, including the effect of the electric field present in the base, is presented for general base boundary conditions. Expressions are derived for the electric field intensity and minority carrier density throughout the base. The base stored charge is determined, as well as its rate of change with minority-carrier current, which is shown to be inversely proportional to the characteristic frequency of the transistor. The quasi-Fermi levels throughout the transistor are considered, and the total voltage drop across the transistor is determined for general boundary conditions. Junction boundary relations are considered, and the limitations of the usual boundary conditions are presented. The equations pertaining to the diffusion transistor are modified by the inclusion of base recombination, assuming this to obey the mass-action law. The equations of the drift transistor, including base recombination according to the mass-action law, are derived. Results are given corresponding to those presented for the diffusion transistor including base recombination. In addition, the variation of certain parameters of the incremental equivalent circuit is briefly presented. (Contractor's abstract)

2647

Stanford U. Stanford Electronics Labs., Calif.

THEORETICAL LIMITATIONS OF GAIN AND BANDWIDTH IN WIDE-BAND TRANSISTOR AND ESAKI DIODE AMPLIFIERS, by J. S. Logan. Sept. 20, 1960,

115p. incl. refs. (Technical rept. no. 1753-1) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 243759 Unclassified

An attempt is made to establish rigorously the ultimate limitations on gain and bandwidth of transistor wideband amplifiers. A primary restriction in the study is that the limitations be derived for amplifiers which are either completely or approx unilateral. Results are obtained for unilateralized common-base and common-emitter amplifier cascades. A scattering matrix description of the interstage is used, leading to integral constraints upon power gain as a function of frequency. The integrals are evaluated for an idealized power gain response which gives a measure of ultimate amplifier performance in terms of equivalent circuit parameters. Relative merits of common-base and common-emitter amplifiers are discussed. Two examples of transistor amplifier interstage design are presented, showing how closely one can estimate performance in a given situation using the derived limitations. It is also shown how the methods used to derive the limitations lead directly to a design procedure. Gain-bandwidth limitations for Esaki-diode linear amplifiers are derived using the same techniques as for transistor interstages. Three different amplifier types are considered and compared, and a design example is presented. (Contractor's abstract)

2648

Stanford U. Stanford Electronics Labs., Calif.

LINEARIZATION OF CONTACTOR CONTROL SYSTEMS BY EXTERNAL DITHER SIGNALS, by T. Ishikawa. Oct. 1, 1960, 29p. incl. illus. (Technical rept. no. 2103-2) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 244952 Unclassified

The problem studied is a linearization of control systems having nonlinear components, such as relays with dead-zone or hysteresis, by an application of high frequency signals to the non-linear devices. Such signals are called "dithers". The linearization problem is regarded as the establishment of a linear relation between the input and the output of the nonlinear element with respect to the average or the mean. With this consideration, the mean of the output is computed in terms of the statistics of the dither for dc input which may include slowly varying signals. The output means are computed for contactors with imperfections for periodic and random-wave dithers. It is shown that by the use of a triangular wave, contactors with dead-zone or with hysteresis can be linearized perfectly between the saturation limits. A number of experiments have been performed on an analog computer to study the system application of the dither. It is shown that periodic waves can linearize contactor systems quite well. It is found that a random noise can also be used as the dither. (Contractor's abstract)

2649

Stanford U. Stanford Electronics Labs., Calif.

AN ADAPTIVE "ADALINE" NEURON USING CHEMICAL "MEMISTORS", by B. Widrow. Oct. 17, 1960, 23p. incl. illus. refs. (Technical rept. no. 1553-2) (Sponsored jointly by Air Force Office of Scientific Research, Office of Naval Research, and Signal Corps under Nonr-22524) AD 244790 Unclassified

A new circuit element called a "memistor" (a resistor with memory) has been devised that will have general use in adaptive circuits. With such an element it is possible to get an electronically variable gain control along with the memory required for storage of the system's experiences or training. Experiences are stored in their most compact form, and in a form that is directly usable from the standpoint of system functioning. The element consists of a resistive graphite substrate immersed in a plating bath. The resistance is reversibly controlled by electroplating. The memistor element has been applied to the realization of adaptive neurons. Memistor circuits for the "Adaline" neuron, which incorporate its simple adaption procedure, have been developed. It has been possible to train these neurons so that this training will remain effective for weeks. Steps have been taken toward the miniaturization of the memistor-element. The memistor promises to be a cheap, reliable, mass-producible, adaptive-system element. (Contractor's abstract)

2650

Stevens Inst. of Tech. Dept. of Physics, Hoboken, N. J.

PLASMA PHYSICS. LECTURE NOTES, CHAPTER I-II, by G. Schmidt. 1960, 62p. incl. diagrs. refs. (AFOSR-TN-60-1481) (AF 49(638)156) AD 248991 Unclassified

The motion of charged particles in electromagnetic fields is developed from general physical principles. A description is given of the guiding center approximation as found in a static magnetic field. Particle motion in fields with spatial symmetry, adiabatic invariants, time varying electric and high frequency fields, and the oscillation center approximation are some of the topics developed.

2651

Stevens Inst. of Tech. Dept. of Physics, Hoboken, N. J.

PLASMA PHYSICS. LECTURE NOTES, CHAPTER III-IV, by G. Schmidt. 1960, 80p. incl. diagrs. refs. (AFOSR-TN-60-1482) (AF 49(638)156) AD 249246 Unclassified

Chapter III shows that plasma equations, under certain limiting conditions, can be simplified and brought to a quasi-hydrodynamic form. The Boltzmann equation and its moments and solutions, the thermodynamic properties

of plasmas, various conservation laws are topics considered, the properties of conductive fluids are studied in Chapter IV. The results are compared with the plasma equations obtained and the limits of applicability of the hydromagnetic treatment of plasmas are analyzed.

2652

Stevens Inst. of Tech. [Dept. of Physics] Hoboken, N. J.

A HIGH EFFICIENCY PLASMA MOTOR, by W. H. Bostick and H. Byfield. [1960] [7]p. incl. illus. diagrs. (AFOSR-1445) (Sponsored jointly by Air Force Cambridge Research Center under AF 19(604)4086, Air Force Office of Scientific Research under AF 49(638)156, and Atomic Energy Commission under AT(30-1)1921) AD 265302 Unclassified

Also published in Proc. Eleventh Internat'l. Astronaut. Cong., Stockholm (Sweden) (Aug. 15-20, 1960), Vienna, Springer-Verlag, v. 1: 210-214, 1961.

A pulsed coaxial crater gun which generates a plasma from the end of a small diameter metallic wire is capable of converting 32% of the energy in a stored capacitor to kinetic energy of the plasma as measured by a calorimeter. The motor requires no switch, only a small trigger. Its efficiency is constant down to low energy inputs and the gun is operated successfully over energy inputs from 3 joules to about 100 joules per pulse. Specific impulses are in the region of 2000 sec, measurements of speed and shape of the plasma have been obtained with a Kerr cell. Plasma speed has also been measured with a calendulum (combination ballistic pendulum and calorimeter) and with a velocity profile measuring instrument. (Contractor's abstract)

2653

Stevens Inst. of Tech. [Dept. of Physics] Hoboken, N. J.

OBSERVATION OF APPARENT FLUTE-TYPE PLASMA INSTABILITY, by H. Dickinson, W. H. Bostick and others. [1960] [2]p. incl. illus. diagr. (AFOSR-1655) (Also bound with its AFOSR-55) (Sponsored jointly by Air Force Cambridge Research Center, Air Force Office of Scientific Research under [AF 49(638)156] and Atomic Energy Commission) AD 265302 Unclassified

Published in Phys. Fluids, v. 3: 480-481, May-June, 1960.

Kerr-cell photographs of hydromagnetic interchange (flute-type) instability of a plasma which is decelerated in a magnetic field are shown.

2654

Stevens Inst. of Tech. Dept. of Physics, Hoboken, N. Y.

EXPERIMENTAL STUDY OF HIGH-TEMPERATURE PLASMA EXPANDING PERPENDICULAR TO A MAGNETIC FIELD AND THE RESULTING RAYLEIGH-TAYLOR INSTABILITY, by H. Dickinson, W. H. Bostick and others. [1960] [43]p. incl. illus. diagrs. refs. (AFOSR-1656) (Also bound with its AFOSR-55) [AF 49-(638)156] AD 265302 Unclassified

A clear, experimental observation of Rayleigh-Taylor, flute-type instability in a high temperature plasma expanding across a magnetic field has been made with time-delay, Kerr cell, sequence photography. The wavelength and growth rate of the instability are measured as a function of time for various values of external magnetic field and background gas pressure. With interface decelerations of about 10^9 m/sec^2 the instability developed in 1-4 μsec with wavelengths of about 10^{-2} m. After 1-4 μsec the flutes grow with constant velocity. (Contractor's abstract)

2655

Stevens Inst. of Tech. Dept. of Physics, Hoboken, N. J.

BEHAVIOR OF PLASMOIDS IN A MAGNETIC FIELD IN A VACUUM, by W. H. Bostick. [1960] [16]p. incl. diagrs. (AFOSR-1657) (Also bound with its AFOSR-55) [AF 49(638)156] AD 265302 Unclassified

The way in which a plasmoid crosses a magnetic field in a vacuum is analyzed. Calculations on the extent of its loss of population and its deceleration in doing so are presented. (Contractor's abstract)

2656

Stevens Inst. of Tech. Dept. of Physics, Hoboken, N. J.

STUDIES ON PROPULSION OF PLASMA (Abstract), by W. H. Bostick, G. Schmidt, and others. [1960] [1]p. (Bound with its AFOSR-TN-60-405; AD 235949) (AF 49(638)156) Unclassified

Presented at Third AFOSR Contractors meeting on Ion and Plasma Propulsion, Republic Aviation Corp., Farmingdale, N. Y., Mar. 22-24, 1960.

Studies are being conducted on the problems involved in the construction and operation of the following types of plasma motors: (1) A coaxial rail-type motor 30 cm long, inner conductor diam 0.5 cm, outer conductor diam 2 cm, with a pulsed gas valve, capacitor max energy storage 2400 j; (2) A coaxial crater motor which is triggered but requires no switch. The plasma is derived from the evaporation of a portion of the end of a metallic wire (in this case D_2 loaded Ti). Acceleration is produced by the high grad H resulting from the large ratio

of the ceramic hole diam and outer conductor diam, and by the resultant coaxial motor effect made possible by the jet of plasma which becomes the center conductor of the coaxial system. Overall efficienceis of 32% were measured for this motor; and (3) A pulsed, funnel shaped, axial field for producing electrodeless acceleration of plasma. Momentum and energy measurements are performed with a calendulum. A plasma velocity-profile-measuring-instrument was employed. Velocity measurements were also conducted with a Kerr cell. (Contractor's abstract)

2657

Stockholm U. Psychological Lab. (Sweden).

A SIMPLE METHOD FOR FITTING PSYCHOPHYSICAL POWER FUNCTIONS, by G. Ekman. May 26, 1960, 7p. incl. diagrs. table. (Technical scientific note no. 1) (AFOSR-TN-60-1085) (AF 61(052)300) AD 244876; PB 152535 Unclassified

Also published in Jour. Psychol., v. 51: 343-350, 1961.

The psychophysical power function may be written in the form $R = c(S - a)^n$, where (c) is related to the arbitrary unit of measurement, (a) is a constant which may be related to the absolute threshold, and the exponent (n) is the main characteristic of the function. If (a) approximates 0, the fitting of a power function involves the fitting of a straight line to a log-log plot. If (a) is not negligible, an iterative least squares solution is possible. A very simple method which combines graphic and algebraic procedures is described.

2658

Stockholm U. [Psychological Lab.] (Sweden).

AN APPARATUS FOR EXPERIMENTS ON VELOCITY PERCEPTION, by G. Lenning and M. Mashhour. Oct. 19, 1960, 7p. incl. diagrs. (Technical scientific note no. 2) (AFOSR-737) (AF 61(052)300) AD 262147 Unclassified

An apparatus is described, which is being used for certain experiments on velocity perception and which has to meet certain specified requirements. The electronical set-up permits continuous and independent variation in any direction of the velocity of 2 stimulus patterns form zero (below the absolute threshold) to a high value (beyond the upper threshold). (Contractor's abstract)

2659

Stockholm U. Psychological Lab. (Sweden).

PSYCHOPHYSICAL RELATIONS IN VISUAL PERCEPTION OF LENGTH, AREA AND VOLUME, by G. Ekman and K. Junge. Oct. 26, 1960, 13p. incl. diagrs. tables. (Technical scientific note no. 3) (AFOSR-738) (AF 61-(052)300) AD 262148 Unclassified

Also published in Scand. Jour. Psychol., v. 2: 1-10, 1961.

Subjective length, area and volume as functions of the corresponding stimulus variables were studied in 3 experiments. The exponents of the psychophysical power functions varied around 1 for perception of real space. For perspective drawings of cubes and spheres, however, the exponents were about 0.75. It was tentatively concluded that perspective is an insufficient cue to visual volume. The results are discussed with special reference to certain cartographic symbols representing population magnitude. (Contractor's abstract)

2660

Stockholm U. [Psychological Lab.] (Sweden).

SCALES FOR SUBJECTIVE DISTANCE, by T. Kunnapas. Nov. 1, 1960, 8p. incl. diagrs. table, refs. (Technical scientific note no. 4) (AFOSR-739) (AF 61(052)300) AD 262360 Unclassified

Presented at Sixteenth Internat'l. Cong. of Psychol., Bonn (Germany), Aug. 1960.

Also published in Scand. Jour. Psychol., v. 1: 187-192, 1960.

Scale values were obtained for subjective distance by means of the method of ratio estimation. In 3 experiments different stimulus ranges of the objective distances were used. It was found that: (1) subjective distance is a power function of the objective distance and (2) the exponent of the function varies with the stimulus range. (Contractor's abstract)

2661

Stockholm U. [Psychological Lab.] (Sweden).

A NOTE ON THE SUBJECTIVE SPEED OF MANUAL WORK, by G. Ekman and A. Herbert. Nov. 20, 1960, 4p. incl. diagrs. table. (Technical scientific note no. 5) (AFOSR-740) (AF 61(052)300) AD 262152 Unclassified

Also published in Scand. Jour. Psychol., v. 1: 177-180, 1960.

A preliminary experiment is described, in which the speed of three manual activities was estimated by the method of magnitude estimation. Within the rather narrow stimulus range of 1/1.35 the subjective range was 1/1.86 for card dealing, 1/1.64 for shoveling gravel, and 1/1.41 for packing. Tentative interpretations of these differences are discussed. (Contractor's abstract)

2662

Sundstrand Machine Tool Co. Sundstrand Turbo Div., Rockford, Ill.

ANALYSIS AND MEASUREMENT OF CHEMICAL CONVERSION TIME IN A LIQUID FUEL ROCKET ENGINE WITH DISTRIBUTED COMBUSTION, by L. L. Bixson. July 26, 1960, 21p. incl. diagrs. (Rept. no. S/TD 1855; technical note no. 8) (AFOSR-TN-60-886) (AF 18-(603)107) AD 243095 Unclassified

An analysis of combustion chamber pressure decay for both concentrated and distributed combustion is extended for the case of distributed combustion to permit direct, reasonably accurate computation of chemical conversion time from experimentally obtained pressure decay histories. Data are presented to support the use of the distributed combustion model for the LOX, RP-1 propellant system. Studies show excellent agreement between the upper third of the theoretical and experimental chamber pressure decay curves. The divergence in the lower portion of the 2 curves is explained by the probability of combustion ceasing within the upper 30% of the decay curve and by the occurrence of a simple gas blowdown process from that point on to where choked nozzle relations no longer hold. (Contractor's abstract)

2663

Sundstrand Machine Tool Co. Sundstrand Turbo Div., Rockford, Ill.

OVERALL CHEMICAL CONVERSION TIME FOR A MODEL FUEL SPRAY (Abstract), by S. S. Penner and L. L. Bixson. Dec. 1960, 4p. incl. illus. (Rept. no. S/TD 1876; technical note no. 9) (AFOSR-156) (AF 18-(603)107) AD 252707 Unclassified

An investigation was made to relate the chemical conversion time (τ_c) to the sensitive time lag (τ_s) in liquid rockets, in order to provide a valid empirical method for evaluating combustion efficiency and high-frequency scaling rules. A complete solution to the problem requires an analytical expression which relates τ_c to the parameters of injection and combustion. Equations are given which are based on a simplified 1-dimensional model of spray burning.

2664

Sydney U. School of Physics (Australia).

THE PRODUCTION AND PROPERTIES OF MESONS AT HIGH ENERGIES, by F. A. Brisbout, C. Gauld and others. [1960] 34p. incl. diagrs. tables, refs. (AFOSR-TN-60-1379) (AF 49(638)842) AD 611466 Unclassified

Also published in Nuclear Phys., v. 26: 634-648, Sept. 1961.

Results from a 10 l stack of Ilford K5 emulsion flown to 126,000 ft are presented. It is shown that the transverse momentum spectrum of the secondary particles of jets has 2 peaks at about 0.4 and 2.0 bev/$_c$ respectively, and possibly a third peak at about 8 bev/$_c$; that the interaction cross section of secondary pions is considerably smaller than the geometric value; that the interactions they produce in emulsions have a lower average multiplicity than proton produced interactions in the same energy range; and that the number of particles/interaction close to the forward direction is less than that expected from extrapolation from slightly greater angles. The results are compared with those of other experiments and their meaning discussed. (Contractor's abstract)

2665

Sydney U. School of Physics (Australia).

THE ELECTRON DENSITY SPECTRUM OF AIR SHOWERS AT DENSITIES GREATER THAN 1000 PARTICLES PER METRE, by R. J. Reid, K. Gopaulsingh and others. [1960] 20p. incl. diagrs. table, refs. (AFOSR-TN-60-1380) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)842] and Nuclear Research Foundation) Unclassified

The density spectrum of cosmic ray air showers has been measured using Wilson cloud chambers in 2 different density regions. From 100 to 600 particles per meter^2 the differential spectrum can be approximated by a power law of exponent -2.5, in good agreement with previous results. Above 1100 particles per meter^2 the measured exponent is -3.9 ± .5. The result is compared with recent experiments using emulsion chambers and an explanation is outlined. (Contractor's abstract)

2666

Sydney U. School of Physics (Australia).

THE FRAGMENTATION PROBABILITIES OF FAST HEAVY COSMIC-RAY PRIMARIES IN TEFLON, by F. A. Brisbout, C. F. Gauld, and C. B. A. McCusker. [1960] [3]p. incl. table. (AFOSR-413) (AF 49(638)842) Unclassified

Also published in Nuovo Cimento, Series X, v. 18: 400-402, Oct. 16, 1960.

A sandwich stack of nuclear emulsions and Teflon sheets was exposed, and the fragmentations occurring in nuclear emulsions were compared with those in Teflon whose average z is close to that of the atmosphere. The results seem to agree with those of other workers, justifying the use of Teflon.

2667

Sydney U. School of Physics (Australia).

THE DIFFERENTIAL ELECTRON DENSITY SPECTRUM OF AIR SHOWERS AT HIGH DENSITIES, by R. J. Reid, K. Gopaulsingh and others. [1960] [11]p. incl. illus. diagrs. table, refs. (AFOSR-3380) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)842] and Nuclear Research Foundation) AD 426580 Unclassified

Also published in Proc. Phys. Soc. (London), v. 78: 103-112, 1961.

The density spectrum of cosmic-ray air showers has been measured using Wilson cloud chambers in 2 different density regions. From 50 to 500 particles per square meter the differential spectrum can be approximated by a power law of exponent -2.5, in good agreement with previous results. Above 1100 particles per square meter the measured exponent is -3.9 ± 0.5. The result is compared with recent experiments using emulsion chambers and an explanation is offered in terms of the characteristics of high energy nuclear interactions. (Contractor's abstract)

2668

Syracuse U. [Dept. of Mathematics] N. Y.

ITERATIONS WITH ERRORS, by P. Frank. Aug. 1960, 16p. (Research rept. no. 28) (AFOSR-TN-60-1095) (AF 49(638)265) AD 245277; PB 152736 Unclassified

Let M be a complete metric space, and T a transformation of M into itself. The following seven sections are discussed: (1) M a complete metric space, no errors; (2) M a complete metric space, bounded errors; (3) M the real numbers, errors random; (4) M a Banach space, errors random; (5) Markov processes and integral equations; (6) M a Banach space, T a linear transformation; and (7) M the real numbers, errors bounded. (Contractor's abstract)

2669

Syracuse U. [Dept. of Mathematics] N. Y.

ON THE MEASURABILITY OF FUNCTIONS IN TWO VARIABLES, by M. Mahowald. Aug. 1960, 6p. (Research rept. no. 29) (AFOSR-TN-60-1096) (AF 49-(638)265) AD 245278; PB 152737 Unclassified

Also published in Proc. Amer. Math. Soc., v. 13: 410-411, 1962

The question of joint measurability of a function of 2 variables given continuity in 1 and another condition is studied. The main result is a general theorem on metric compact spaces which states that if Y is metric and if f(x, y) has a measurable modification and f(x·) is continuous for almost all x, then f(x, y) is measurable in both variables together. Necessary and sufficient conditions that a real valued stochastic process have a measurable modification are also obtained.

2670

Syracuse U. [Dept. of Mathematics, N. Y.]

PROBABILISTIC METHODS IN MARKOV CHAINS, by K. L. Chung. Oct. 1960, 34p. (Research rept. no. 27) (AFOSR-TN-60-1243) (AF 49(638)265) AD 241632 Unclassified

Also published in Proc. Fourth Berkeley Symposium on Mathematical Statistics and Probability, California U., Berkeley (June 20-July 30, 1960), Los Angeles, California U. Press, 1961, v. 2: 35-56. (AFOSR-2135)

A survey is presented of recent results in Markov chain theory which emphasizes the interplay between its analytic and stochastic aspects. The connection is demonstrated between the structure of the transition matrix and the behavior of the sample functions. Aspects considered include continuity and differentiability of certain non-negative functions, the strong Markov property, transitions to and from a stable state, first entrance and last exit to and from a stable state, and the concept of first infinity for a process having the given Markov properties.

2671

Syracuse U. [Dept. of Mathematics] N. Y.

SOME REMARKS ON TABOO PROBABILITIES, by K. L. Chung. Oct. 1960, 8p. (Research rept. no. 30) (AFOSR-TN-60-1244) (AF 49(638)265) AD 247242 Unclassified

Also published in Illinois Jour. Math., v. 5: 431-435, Sept. 1961.

A discrete parameter homogeneous Markov chain x_n, $n = 0$ with state space I and one-step transition matrix (p_{ij}), $i, j \in I$ is considered. For any subset H of I, the taboo probability $H^{p_{ij}^{(n)}} = P\{x_n = j; x_v \notin H, 0 < v < n \mid x_0 = i\}$, $n \geq 1$, is defined and one set $H^{p_{ij}} = \sum_{n=1}^{\infty} H^{p_{ij}^{(n)}}$. Corollaries of results arrived at elsewhere are shown to be caused by a generalization of a result from Spitzer, which is proven here. A new binary relation is defined between the states of a Markov chain.

2672

Syracuse U. [Dept. of Mathematics] N. Y.

A NOTE ON THE ERGODIC THEOREM OF INFORMATION THEORY, by K. L. Chung. Oct. 1960, 4p. (Research rept. no. 31) (AFOSR-TN-60-1245) (AF 49-(638)265) AD 247243 Unclassified

Also published in Ann. Math. Stat., v. 32: 612-614, June 1961.

The result of Breiman is extended to an infinite alphabet, or equivalently, the result of Carleson to convergence with probability one. The first theorem proved shows that $H = -\underline{E}\{\lg p(x_0)\} = -\sum_{i=1}^{\infty} p_i \lg p_i < \infty$, where "lg" is the logarithm to the base 2. This implies $\underline{E}\{\sup_{0 \le k < \infty} g_k\} < \infty$, and consequently $\lim_{n \to \infty} \frac{1}{n} \lg p(x_0, \cdots, x_{n-1}) = -H$.

2673

Syracuse U. Dept. of Mathematics, N. Y.

MARKOV CHAINS WITH STATIONARY TRANSITION PROBABILITIES, by K. L. Chung. [1960] 278p. incl. refs. (AFOSR-521) [AF 49(638)265] Unclassified

Also published in Die Grundlehren der Mathematischen Wissenschaften in Einzedarstellungen, Berlin (Germany), Springer-Verlag, v. 104: 1-278, 1960.

The theory of Markov chains is developed, not as a special case of Markov processes, but for its own sake and presented on its own merits. In general, the hypothesis of a denumerable state space generates more clear-cut questions and demands more precise and definitive answers than the general Markov processes. The principal limit theorem, still the object of research for general Markov processes, is presented here in its neat final form. The book is divided into two sections, the first dealing with discrete parameters and the second with continuous parameters.

2674

Syracuse U. [Dept. of Mathematics] N. Y.

RADIAL DISTRIBUTION AND DEFICIENCIES OF THE VALUES OF A MEROMORPHIC FUNCTION, by A. Edrei, W. H. J. Fuchs, and S. Hellerstein. [1960] [17]p. (AFOSR-TN-60-337) (AF 49(638)571) AD 237516; PB 146926 Unclassified

Also published in Pacific Jour. Math., v. 11: 135-151, 1961.

Let f(z) be a meromorphic function and let $\Delta(t, f)$ denote the deficiency of the value t. Certain simple behaviors in the arguments of the zeros and the poles of f(z) are shown to be almost sufficient to induce the inequalities $\Delta(0, f) > 0$, $\Delta(\infty, f) > 0$. The following are investigated: (1) meromorphic functions with positive zeros and negative poles, (2) entire functions with real zeros, and (3) entire functions with zeros distributed on a finite number of radii passing through the origin.

2675

Syracuse U. [Dept. of Mathematics] N. Y.

ON THE MAXIMUM NUMBER OF DEFICIENT VALUES OF CERTAIN CLASSES OF FUNCTIONS, by A. Edrei and W. H. J. Fuchs. Apr. 1960 [38]p. incl. refs. (AFOSR-TN-60-402) (AF 49(638)571) AD 239448; PB 148414 Unclassified

Let f(z) be meromorphic and let m(r, f) and T(r, f) be the quantities which play a fundamental role in Nevanlinna's theory. The $\liminf_{r \to \infty} \frac{m(r, \frac{f}{f'})}{T(r, f)}$ is shown to be equal to zero, provided f(z) has its zeros and poles distributed on a finite number of radii passing through the origin and its order is either infinite or finite, but not too small. (Contractor's abstract)

2676

Syracuse U. [Dept. of Mathematics] N. Y.

INVERSE THEOREMS OF APPROXIMATION, by G. G. Lorentz. Sept. 25, 1960, 16p. (AFOSR-TR-60-21) (AF 49(638)619) AD 245103 Unclassified

Several theorems are considered which give a lower estimate for the degree of approximation of functions f of a given class by means of linear combinations $P = a_1 g_1 + \ldots + a_n g_n$. The distance from f to P is measured in the C- and the L^1-norm. (Contractor's abstract)

2677

Syracuse U. [Dept. of Mathematics] N. Y.

LOWER BOUNDS FOR THE DEGREE OF APPROXIMATION, by G. G. Lorentz. [1960] [10]p. (AFOSR-3601) (AF 49(638)619) Unclassified

Also published in Trans. Amer. Math. Soc., v. 97: 25-34, Oct. 1960.

Let X be a Banach space of real or complex valued functions f defined on a compact metric space A. Let $G = \{g_1, \ldots, g_n, \ldots\}$, $g_n \in X$. $D_n(\mathfrak{U}) = \inf_G E_n^G(\mathfrak{U})$ is the optimal degree of approximation of $\mathfrak{U}$. Methods are presented

which permit the finding of the order of magnitude of $D_n(\mathfrak{U})$ for several important classes $\mathfrak{U}$. Results show that standard means (trigonometric approximation, series of orthogonal polynomials) give the best possible approximation, at least up to a bounded factor. Estimates of $D_n(\mathfrak{U})$ from above follow classical results; interest in estimating $D_n(\mathfrak{U})$ from below are considered since the smaller the norm used in the definition, the better the results.

2678

Syracuse U. [Dept. of Mathematics] N. Y.

APPROXIMATION OF SMOOTH FUNCTIONS, by G. G. Lorentz. [1960] [2]p. (AFOSR-3602) (AF 49(638)619) Unclassified

Published in Bull. Amer. Math. Soc., v. 66: 124-125, Mar. 1960.

Let $\omega(h)$ be an increasing continuous subadditive function, $\omega(0) = 0$, $h \geq 0$. A denotes a compact metric space, C_1^{ω} the set of all real-valued functions f on A with $|f(x)| \leq 1$, $|f(x)-f(x')| \leq \omega(h)$, $h = p(x,x')$. If A is a q-dimensional cube, p is a natural number, and $0 \leq \alpha < 1$, then $C_1^{p+\alpha}$ may be used to denote the class of all functions with partial derivatives of order p satisfying a Lipschitz condition of order α. Let $G = \{g_n\}$ be a sequence of continuous functions on A.

$$E_n(f) = \inf \|f - \sum_1^n a_i g_i\|; \quad E_n(W) = \sup E_n(f), \quad f \in W.$$

The following general principle is stated: An estimate of $E_n(C_1^{p+\alpha})$ from below can be given for an arbitrary system G, and the trigonometric system is close to the best possible. (1) Let $\delta = \delta(n)$ be the largest number such that there exist n points of A with mutual distances $\geq \delta$. Then for each G, $E_n(C_1^{\omega}) \; 1/2\omega(\delta\,(n+1))$. (2) If A is a q-dimensional cube, then for some constant B and each G (for example in L^1 norm) $E_n(C_1^{p+\alpha}) \geq Bn^{-(p+\alpha)/q}$ $(p = 0,1,..;\ 0 < \alpha < 1)$. From these theorems are obtained similar results for $E_n(f)$. No proofs are given. (Math. Rev. abstract)

2679

Syracuse U. [Dept. of Mathematics, N. Y.]

UNIFORM APPROXIMATION BY POLYNOMIALS WITH POSITIVE COEFFICIENTS, by W. B. Jurkat and G. G. Lorentz. [1960] [11]p. (AF 49(638)619) Unclassified

Published in Duke Math. Jour., v. 28: 463-474, Sept. 1961.

Let A be a compact Hausdorff space, $C^+(A)$ the cone of all non-negative continuous functions on A. Under what conditions are the positive linear combinations, or positive polynomials, in the elements of a given set $G \subset C^+(A)$ uniformly dense in $C^+(A)$? "Positive" here means "with positive coefficients". Several results are given concerning these problems, particularly for linear sets A. (1) The positive polynomials in two elements g_1, g_2 are dense in $C^+(A)$ (A arbitrary) if and only if for any three points x_0, x_1, x_2 of A, not all identical, and for any members $\alpha_1 > 0$, $\alpha_2 > 0$, $\alpha_1 + \alpha_2 = 1$, the inequality $g(x_0) > g(x_1)^{\alpha_1} g(x_2)^{\alpha_2}$ holds for $g = g_1$ or $g = g_2$. Definition: A positive function g is strictly multiplicatively convex on $A_1 \subset [0, \infty]$ if $g(x_0) > g(x_1)^{\alpha_1} g(x_2)^{\alpha_2}$ holds whenever $x_0 = x_1^{\alpha_1} x_2^{\alpha_2}$, $x_1 < x_0 < x_2$, $\alpha_1 > 0$, $\alpha_2 > 0$, $\alpha_1 + \alpha_2 = 1$, $x_0, x_1, x_2 \in A_1$. (2) Let A be a compact subset of [0, 1] and $g \in C^+(A)$. Then the positive polynomials in x, g(x) are dense in $C^+(A)$ if and only if g is strictly increasing and strictly multiplicatively convex on A. The problem of approximation by positive polynomials in x, y, g(x, y) is also solved for certain sets A in the (x, y)-plane.

2680

Syracuse U. [Dept. of Mathematics] N. Y.

REMARK ON A PAPER OF VISSER, by G. G. Lorentz. [1959] [4]p. (AFOSR-3604) (AF 49(638)619) AD 428412 Unclassified

Also published in Jour. London Math. Soc., v. 35: 205-208, Apr. 1960.

Proof is offered of the following theorem which sharpens a previous result of L. Sucheston (Jour. London Math. Soc., v. 34: 386-394, 1959). Let E be a measure space with measure μ, $\mu(E) = 1$, and let M(f) be the corresponding integral. Let $f_n(x)$, $1 \leq n < \infty$, be a sequence of measurable functions satisfying $0 \leq f_n(x) \leq 1$. C. Visser ((Nederl. Akad. Wetensch. Proc., v. 40: 358-367, 1937) and J. Gillis (Nederl. Akad. Wetensch. Proc., v. 11: 139-141, 1936) showed that if $M(f_n) \geq \alpha > 0$ then for each $s \geq 1$ and each $\epsilon > 0$ there exists a subsequence g_n of f_n with $M(g_{n_1} \cdots g_{n_s}) \geq (1 - \epsilon)\alpha^s$. The author now proves: Let $\liminf_{n_1 \to \infty} M(f_{n_1} \cdots f_{n_r}) = \alpha^r$, $r > 0$. Then for each $\epsilon > 0$ there exists a subsequence g_n of f_n such that $M(g_{n_1} \cdots g_{n_s}) \geq (1 - \epsilon)\alpha^s$, $s = r, r+1, \ldots$. (Math. Rev. abstract)

2681

Syracuse U. [Dept. of Mathematics] N. Y.

CONCAVE FUNCTIONS, REARRANGEMENTS, AND BANACH LATTICES, by B. J. Eisenstadt and G. G. Lorentz. [1959] [10]p. incl. refs. (AFOSR-3605) (In cooperation with Wayne State U., Detroit, Mich.) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)619] and National Science Foundation under G-1975) Unclassified

Also published in Michigan Math. Jour., v. 7: 161-170, 1960.

Let B be an non-atomic σ-Boolian ring and μ a strictly positive, countably additive measure on B but $\mu(f) < +\infty$, $f \leq e$ $\mu(f) = \mu e$. For a countably additive measure φ on B with $\varphi(e) < +\infty$ for $\mu(e) < +\infty$, putting $\varphi^*(e) = \sup_{\mu(f) = \mu(e)} \varphi(f)$ a function φ^* is obtained on B.

An attempt is made to characterize such a function φ^*. (Math. Rev. abstract)

2682

[Syracuse U. Dept. of Mathematics, N. Y.]

TAUBERIAN THEOREMS, by H. R. Pitt, reviewed by G. G. Lorentz. [1960] [2]p. (AFOSR-3606) [AF 49-(638)619] Unclassified

Also published in Bull. Amer. Math. Soc., v. 66: 12-13, Jan. 1960.

A discussion of very general Tauberian conditions and of slowly decreasing functions is given in Chapter I-III, followed by elementary general Tauberian theorems and theorems in which boundedness of g(u) implies that of s(v). Special Tauberian theorems are given for the methods of Cesaro, Riesz, Obel and Borel. The main theorem: if the kernel of $g(u) = \int_{-\infty}^{+\infty} k(u,v)s(v)dv$ is $k(u-v)$, if $K(t) \neq 0$ and if s(v) is bounded, then $S \leq \epsilon + C(\epsilon)G$, when $S = \limsup|s(v)|$, $G = \limsup|g(u)|$, is proved in Chapters IV-V and other classical Wiener theorems are discussed. Chapter VI deals with proofs of the prime number theorem containing Tauberian ideas.

2683

Syracuse U. [Dept. of Physics] N. Y.

(A) COMBINED PARAMAGNETIC RESONANCE INFRARED RADIATION STUDIES IN SILICON, by A. Honig. (B) SHALLOW IMPURITY TRAPS AND ELECTRON TRANSFER DYNAMICS IN n-TYPE SILICON AT LIQUID HELIUM TEMPERATURES, by A. Honig and R. Levitt. Sept. 12, 1960 [12]p. incl. illus. diagrs. refs. (Technical note no. 2) (AFOSR-TN-60-1122) (AF 18-(603)50) AD 249878 Unclassified

Part A also published in Quantum Electronics; a Symposium, High View, N. Y. (Sept. 14-16, 1959), New York, Columbia U. Press, 1960, p. 450-457.

Part B also published in Phys. Rev. Ltrs., v. 5: 93-96, Aug. 1, 1960.

Part A. The excited states of impurities in silicon have been investigated by the simultaneous utilization of paramagnetic resonance and infrared excitation. In a general sense, the paramagnetic resonance selects out particular impurities whose electronic excited state spectrum in the infrared can then be investigated, even in the presence of abundant extraneous impurities. The spin interactions between photoionized conduction electrons and bound electrons in silicon have also been investigated. This report presents some of the findings concerning the bound electron-conduction electron relaxation picture. It is shown that over 90% of the electrons will be excited from phosphorus impurities to energies below 0.02 ev. Experiments on 2 samples of phosphorus-doped silicon indicated a dominant interchange mechanism. Use of more highly doped samples with very small compensation should favor the exchange over the interchange mechanism and perhaps make it possible to evaluate the true exchange cross section. It is observed that the steady-state magnetization of the bound donors is decreased if microwave power is left on during the growth period even though the magnetic field is set considerably off from the main resonance. In the absence of photoexcitation to the conduction band this effect does not occur. This is interpreted as the saturated centers contributing to the conduction electron reservoir spins of high temperature, which mix in the conduction band with electrons from non-saturated cold centers forming an intermediate spin temperature reservoir. Part B. From combined electron spin resonance and photoconductivity experiments on samples of phosphorus-doped silicon with boron compensation, some properties of shallow impurities in silicon are reported. These include the rate of electron transfer from a neutral phosphorus impurity to a neutral boron impurity at various impurity concentrations and temperatures, and the ratio of positive phosphorus ion trapping cross section to neutral boron trapping cross section for conduction electrons. The low-temperature mobility as measured by photo-Hall effect appears to be fairly constant as the P^+ traps are filled, and yet a large photocurrent increase results from a relatively small decrease in impurity ion concentration. The data suggest that at high ion concentrations, the lifetime against trapping for 2-micron extrinsically excited electrons depends more nearly on $(1/P^+)^2$ than on $(1/P^+)$. The total enhancement of the photocurrent indicates the presence of other types of lifetime limiting traps. The extrinsically (2-micron) generated electron's lifetime against trapping, for the equilibrium trap situation where $P^+ = B(2 \times 10^{15}/cm^3$ for the sample under discussion), is determined from the expression $\tau = n_e/SP^0$, where n_e is measured by Hall effect and S is the rate of ionization of P^0. At 4.2°K and 1.3°K, $\tau = 5 \times 10^{-11}$ sec. It is suggested that an appreciable part of the lifetime of the 2-micron extrinsically generated electrons is spent in thermalization.

2684

Syracuse U. Dept. of Physics, N. Y.

RATE OF ELECTRON TRANSFER FROM NEUTRAL SHALLOW DONORS TO NEUTRAL SHALLOW ACCEPTORS IN n-TYPE SILICON AT LIQUID HELIUM TEMPERATURES, by A. Honig. [1960] [4]p. incl. diagrs. (AFOSR-4440) [AF 18(603)50] Unclassified

Published in Proc. Internat'l. Conf. on Semiconductor Physics, Prague (Czechoslovakia) (Aug. 29-Sept. 2, 1960), Prague, Publishing House of the Czechoslovak Academy of Sciences, 1961, p. 610-613.

The rate of electron transfer from a neutral phosphorus donor to a neutral boron acceptor was measured in n-type silicon over a range of concentrations, in the liquid He temperature region. The technique used intrinsic radiation to produce a non-equilibrium state and electron spin resonance to monitor the approach to equilibrium. Electron transfer occurred locally between neighboring phosphorus and boron sites and could also be brought about by delocalizing the electrons with extrinsic radiation. (Contractor's abstract)

2685

Syracuse U. Dept. of Physics, N. Y.

THE CONSTRUCTION AND PROPERTIES OF NON-EQUIBLIBRIUM GIBBSIAN ENSEMBLES, by R. L. W. Chen. July 1960, 31p. incl. diagrs. (AFOSR-TN-60-746) (AF 49(638)461) AD 241048; PB 149872 Unclassified

Methods of constructing Gibbsian ensembles for isolated systems undergoing irreversible processes are discussed and the properties of these ensembles are examined. Different kinds of physical situations call for different types of representative ensembles. In particular, situations are contrasted in which: (1) the system is just beginning an irreversible process, and (2) the system has had some uninterrupted past history. (Contractor's abstract)

2686

Syracuse U. Dept. of Physics, N. Y.

A STATIONARY GIBBSIAN ENSEMBLE, by W. L. Sadowski. July 1960, 54p. (AFOSR-TN-60-824) (AF 49(638)461) AD 240733; PB 149885 Unclassified

The stationary non-equilibrium distribution function is investigated by a specific physical model of the Bergmann-Lebowitz equation derived by integrating the Liouville equation over domains of collision of system particles with those of the reservoir. The kernel of the non-equilibrium problem is expanded in a power series of the temperature difference across the system. The physical significance of the numerical factors of the zeroth-order distribution function and the expansion is discussed. The one-particle distribution function in μ-space is obtained by integrating the first-order n-particle distribution function. It is shown that the resulting heat flux is proportional to $\frac{T_2-T_1}{Q_2-Q_1}$ where Q_2-Q_1 is the length of the system's container along the axis of symmetry.

2687

Syracuse U. Dept. of Physics, N. Y.

NULL ELECTROMAGNETIC FIELDS, by I. Robinson. [1960] [2]p. [AF 49(638)461] Unclassified

Published in Jour. Math. Phys., v. 2: 290-291, May-June 1961.

It is shown that a field of null rays is geodetic and shear-free if and only if the associated family of null bivectors includes a solution to Maxwell's equations for charge free space.

2688

Syracuse U. Dept. of Physics, N. Y.

NOTE ON GAUGE TRANSFORMATIONS IN QUANTUM MECHANICS, by A. O. Barut and M. Leiser. May 1960, 8p. (AFOSR-TN-60-562) (AF 49(638)801) AD 253691 Unclassified

Also published in Amer. Jour. Phys., v. 29: 24-26, Jan. 1961.

Gauge transformations are treated from the point of view of unitary transformations in ordinary mechanics. Gauge-independent form of the constants of the motion is discussed. It is shown that the orbital angular momentum in an arbitrary gauge is given by: $r \times [p - e A) + \frac{1}{2} e (B \times r)] + \frac{1}{2}\sigma'$. (Contractor's abstract)

2689

Syracuse U. Dept. of Physics, N. Y.

γ^5-SYMMETRIZATION AND THE STRONG REFLECTION-INVARIANCE, by A. O. Barut. May 1960, 4p. (AFOSR-TN-60-563) (AF 49(638)301) Unclassified

The principle is used that the form of the Lagrangian density is invariant under the strong reflection transformation of every Fermi field ψ_1 independently. It is shown that the only interactions which conserve parity are non-derivative interactions of scalar bosons and vector mesons interactions involving one Fermi field. That vector meson interactions involving two Fermi

fields must exist in (V ± A) combinations is obtained from this principle also, as from the γ^5-symmetrization. In particular the (V ± A) form of the weak interactions, is obtained from the principle with the exception that parity conserving derivative coupling interactions are allowed although excluded in the scheme using a symmetrized Lagrangian.

2690

Syracuse U. Dept. of Physics, N. Y.

EXTRA SOLUTIONS OF THE DISPERSION RELATIONS AND RESONANCE SCATTERING, by A. O. Barut and K. H. Ruei. [1960] 16p. incl. refs. (AFOSR-TN-60-564) (AF 49(638)801) AD 253692 Unclassified

Also published in Nuclear Phys., v. 21: 300-309, Nov. 1960.

The connection between the extra solutions of the dispersion relations plus the unitary condition and the existence of unstable intermediary states is discussed. It is shown for the potential scattering that both lead to a resonance behavior in the cross-section. The dispersion relation and the unitarity condition describe, therefore, a quantal system whose spectrum is enlarged by the inclusion of unstable intermediate states. (Contractor's abstract)

2691

Syracuse U. Dept. of Physics, N. Y.

THE KEMMER β-FORMALISM FOR PARTICLES OF SPIN ONE-HALF, by A. O. Barut and M. Samiullah. [1960] 6p. (AFOSR-TN-60-565) (AF 49(638)801) AD 253693 Unclassified

Also published in Nuovo Cimento, Series X, v. 17: 876-880, Sept. 16, 1960.

A linearization of the 2-component second order spinor equation of Feynman and Gell-Mann for spin one-half particles leads to a 10 component equation of the Kemmer type. Up to now such equations were only known for integral spin particles. (Contractor's abstract)

2692

Syracuse U. Dept. of Physics, N. Y.

BOSON CURRENTS IN THE THEORY OF WEAK INTERACTIONS, by W. B. Zeleny and A. O. Barut. [1960] [35]p. incl. diagrs. refs. (AFOSR-TN-60-566) (AF 49(638)801) AD 253694 Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 256, Apr. 25, 1960. (Title varies)

Also published in Phys. Rev., v. 121: 908-916, Feb. 1, 1961.

A possible new method of introducing boson currents into the weak interaction is suggested. The Bose fields are assumed to obey the first-order Kemmer equation. In this way, the boson and fermion currents enter the interaction in a symmetric manner. Three coupling constants are introduced according to the degree of isotopic spin and strangeness symmetries of the currents. The interaction so obtained gives rise in a natural way to the $|\Delta T| = 1/2$ selection rule and its violation, and also to fast pionic modes and slow leptonic modes of hyperon decay. First-order calculations are performed for Ke_3^+, τ, and τ' decays. Calculations of the decay rates yield sufficient information to determine the approximate magnitudes of the effective coupling constants. The first-order calculations are at variance with experimentally uniform distribution of τ events in the Dalitz plot. (Contractor's abstract)

2693

Syracuse U. Dept. of Physics, N. Y.

SPIN-ORBIT CORRELATIONS IN μ-e AND e^--e^- SCATTERING, by A. O. Barut and C. Fronsdal. [1960] 8p. (AFOSR-TN-60-754) (In cooperation with CERN, Geneva, Switzerland) (AF 49(638)801) AD 253695 Unclassified

Also published in Phys. Rev., v. 120: 1871-1874, Dec. 1, 1960.

The imaginary part of the fourth order matrix element for the electromagnetic scattering of two fermions gives rise to a small dependence of the cross section on the quantity $s \cdot p_i \times k_1$ where s and p_i are the spin and momenta of one of the initial particles, and k_1 the momentum of the same particle after scattering. The resulting angular asymmetry can probably be measured. The effect does not occur in the lowest order of scattering. (Contractor's abstract)

2694

Syracuse U. [Dept. of Physics] N. Y.

GROUP REPRESENTATIONS WITH AN ARBITRARY INVARIANT METRIC. by A. O. Barut. [1960] 13p. incl. refs. (AFOSR-TN-60-1172) (AF 49(638)801) Unclassified

Group representations are discussed from the point of view of an arbitrary invariant form $(\Psi, \Gamma\Psi)$ in the representation space. The relations between the metric tensor Γ and the corresponding reducible or irreducible

representations D and the criteria for their existence are investigated. Finally the invariant metric used in quantum electrodynamics and in certain wave equations is critically examined in terms of group representations. (Contractor's abstract)

2695

Syracuse U. Dept. of Physics, N. Y.

ANALYTICAL PROPERTIES OF S MATRIX AND UNIQUENESS OF THE SCATTERING POTENTIAL, by A. O. Barut and K. H. Ruei. [1960] [7]p. incl. refs. (AFOSR-3814) (AF 49(638)801) Unclassified

Also published in Jour. Math. Phys., v. 2: 181-187, Mar.-Apr. 1961.

The Schrödinger equation with the complex momentum k leads to an S matrix with very simple analytical properties. It differs from the conventional S matrix as little as one wishes on the real k axis, but it has, in general, completely different analytical behavior outside the real axis. The present formulation removes some of the unsatisfactory features of the conventional formalism in the sense that no redundant poles can occur and a phase shift determines the scattering potential uniquely. The complete analytical behavior of the S matrix, in particular at infinity, is discussed and the theory is extended to Klein-Gordon and Dirac equations with central potential. (Contractor's abstract)

2696

Syracuse U. [Dept. of Physics] N. Y.

POLARIZATION EFFECTS IN THE SCATTERING OF INITIALLY UNPOLARIZED ELECTRONS AND MUONS (Abstract), by A. O. Barut, C. Fronsdal, and A. Peterman. [1960] [1]p. (In cooperation with CERN, Geneva, Switzerland) [AF 49(638)801] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 256, Apr. 25, 1960.

It may be experimentally feasible, in the future, to measure the polarization of high-energy electrons or muons in e-e, e-μ, or perhaps even μ-μ scatterings. The problem is also of some theoretical interest and the calculation of the effect does not involve any renormalization or cutoff. To the second order there is no polarization since the matrix element is real. Results of the lowest order calculations of polarization will be presented which involve the product of the second and the imaginary part of the fourth-order matrix elements. The latter is evaluated directly and also from the unitarity condition.

2697

Syracuse U. Dept. of Psychology, N. Y.

SOME DISPOSITIONAL CORRELATES OF CONFORMITY BEHAVIOR, by F. J. DiVesta and L. Cox. [1960] [10]p. incl. tables, refs. (AFOSR-TN-60-1448) (AF 18(603)20) AD 247072 Unclassified

Also published in Jour. Social Psychol., v. 52: 259-268, 1960.

The Crutchfield technique was used for measuring conformity in a laboratory setting. The evidence in the present study clearly indicates the presence of consistent sources and dispositional characteristics which contribute to individual differences in susceptibility to social influence. Outstanding in these findings is that high and low conformers may be distinguished on the basis of intellectual ability, self-confidence, motivations, and orientations to interpersonal relations. Although no cause and effect relationships can be established on the basis of correlations it may be hypothesized that, for the large part, these factors reflect the culmination of personal experience and the modification of that experience by cultural demands. These experiences in turn, lead to greater or lesser degrees of susceptibility to persuasion by others. (Contractor's abstract)

2698

Syracuse U. Research Inst. Dept. of Physics, N. Y.

OBSERVATION OF A TWO-BODY DECAY MODE OF $_{\Lambda}He^{4}$, by E. M. Harth, J. Leitner, and S. Lichtman. Feb. 1960 [5]p. incl. diagr. table. (AFOSR-TN-60-169) (AF 49(638)588) Unclassified

The production and decay of a He^{4} hyperfragment obtained in an exposure in a He bubble chamber is reported. Evidence for the identification of the event, in particular the decay via the mode $_{\Lambda}He^{4} \rightarrow He^{3} + n$, is discussed. It appears that this is the first 2-body nonmesonic decay mode observed. (Contractor's abstract)

2699

Syracuse U. Research Inst. Dept. of Physics, N. Y.

DATA ANALYSIS SYSTEM FOR BUBBLE CHAMBER PHOTOGRAPHS, by E. Harth, J. Leitner, and Y. I. Rhee. Feb. 1960, 17p. (AFOSR-TN-60-170) (AF 49-(638)586) Unclassified

An analysis technique is described for obtaining space information from coordinate measurements made on reprojected bubble chamber pictures. Measurement is made on a movable viewing screen at about a magnification of about 2. Measurement of 2 corresponding bubbles in each view is sufficient to determine the space kinematics of the event. Measurement of 3 arbitrary points

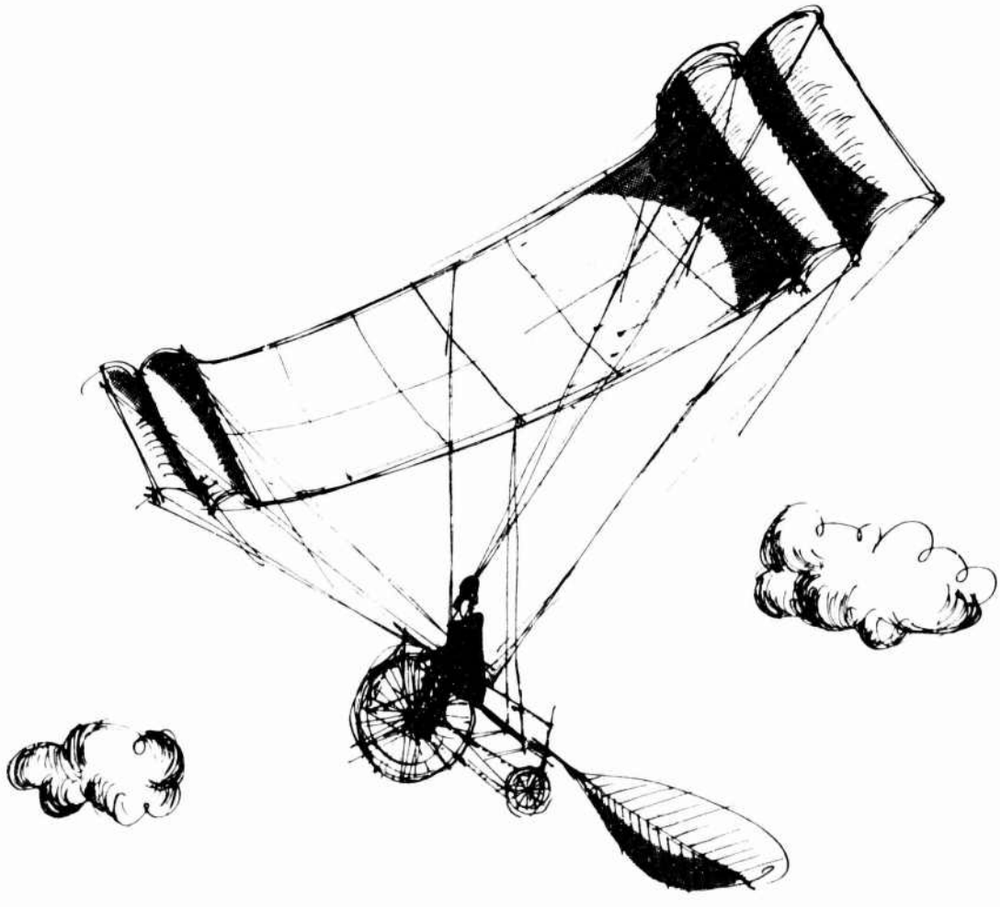
along a track in a single stereo view is sufficient to determine the dynamics of the event. The computational technique is reported in detail for reducing the data in projected space to true space for both geometrical and dynamical quantities, and their errors. The accuracy of the resultant formulae is characterized by an elementary point location error, which incorporates systematic effects such as relative misalignment in projection, etc. The experimentally determined point error is found to be 0.02 cm for measurement of geometrical quantities and about 0.005 cm for measurement of momenta. (Contractor's abstract, modified)

2700

Syracuse U. Research Inst. Dept. of Physics, N. Y.

[EXPERIMENTAL STUDY OF π^--He^4 INTERACTIONS IN THE BEV RANGE AND K^- ABSORPTION AT REST IN HELIUM] by E. M. Harth and J. Leitner. Final rept. [1960] [28]p. incl. diagrs. tables, refs. (AFOSR-TR-60-19) (In cooperation with Helium Bubble Chamber Collaboration Group of Duke U., Durham, N. C., Johns Hopkins U., Baltimore, Md., and Oak Ridge National Lab., Tenn.) (AF 49(638)588) Unclassified

Preliminary results on various phases of the K^--He^4 absorption experiment are reported. The data presented have been compiled from several laboratories. Subjects discussed include parity conservation in the Σ-Λ conversion process, a determination of the relative K-$_\Lambda$ parity, production rate, decay rates, branching ratios of low Z hyperfragments, and details of the impulse approximation treatment of K^--He^4 interactions. Also included are some final results of studies made in cooperation with the Berkeley bubble chamber group on the analysis of a K^--p absorption experiment. These include an upper limit to the Σ-leptonic decay rate, a study of parity conservation in the reaction $K^- + p \rightarrow \Sigma^- + \pi^+$, and a precision determination of the Σ spin. Included are lists of reports printed as a result of this research, as well as those being prepared for publication. (Contractor's abstract)



2701

Technical Research Group, Inc., Syosset, N. Y.

POPULATION ENHANCEMENT IN MERCURY-KRYPTON GASEOUS DISCHARGES, by B. Senitzky, M. [C.] Newstein and others. [1960] [1]p. incl. diagr. [AF 18(600)1313] Unclassified

Published in Jour. Opt. Soc. Amer., v. 51: 367, Mar. 1961.

The enhancement of the mercury levels by krypton is studied with the aid of an electrodeless rf discharge tube containing a mercury reservoir at room temperature and provisions for changing the krypton pressure. Absolute intensity measurements based on the estimated transition probabilities indicate that the population in the enhanced level is about 10^6 atoms/cc. A measure of the reliability of the estimated transition probabilities can be obtained by comparing the theoretical probability ratios with ratios obtained experimentally by measuring absorptions originating on one state and terminating on different upper levels.

2702

Technical Research Group, Inc., Syosset, N. Y.

THEORY OF LASER OSCILLATIONS IN FABRY-PEROT RESONATORS, by J. Kotik and M. C. Newstein. [1960] [9]p. incl. diagrs. (AFOSR-TN-60-400) [AF 49(633)673] AD 289169 Unclassified

Also published in Jour. Appl. Phys., v. 32: 178-186, Feb. 1961.

The Fabry-Perot interferometer has been suggested for use as a high mode LASER (light amplification by stimulated emission of radiation) resonator. The oscillator condition for a Fabry-Perot LASER is derived from an integral equation for the angular spectrum of the field. The kernel of the integral equation involves the scattering matrices of the end mirrors. This integral equation leads to a stationary expression. The use of physically reasonable trial spectra allows one to estimate the effect of "walkoff", diffraction, reflector curvature, and reflector tilt in terms of an "effective" reflection coefficient for the infinite-aperture Fabry-Perot. Taking into account the effect of "walkoff", an approximate necessary and sufficient condition for oscillation normal to the reflectors is derived. (Contractor's abstract)

2703

Technical Research Group, Inc., Syosset, N. Y.

RESEARCH ON PROPERTIES OF LASER DEVICES, by M. C. Newstein and N. Solimene. July 23, 1960, 236p. incl. illus. diagrs. tables, refs. (Rept. no. TRG-134-TR-3) (AFOSR-TN-60-827) (AF 49(638)673) AD 320277 Unclassified

Progress is presented on a program to produce working models of LASER devices. Three experimental programs are being carried out in parallel. The processes by means of which the required population inversions are to be obtained are: (1) collisions of the second kind in gaseous discharges; (2) optical pumping of gases; and (3) optical pumping of condensed systems. In the first scheme, experimental evidence indicates that population inversion has been achieved, but that the presently attained enhanced population is a factor of 10 too small to be practicable for a LASER transition. In the second scheme, fluorescence measurements indicate that sufficient population inversion has been achieved for LASER action in the IR. On the basis of measured fluorescent lifetimes and linewidths, in the third scheme, LASER operations should be achievable at optical frequencies on a pulsed basis for several of the rare earth salts of europium and terbium and ruby. For the last two schemes, attempts to obtain LASER operation are now under way. Various questions concerned with the required dimensional tolerances in the optical cavity are investigated both theoretically and experimentally. A bibliography is given of nearly 300 reprints of articles which have been acquired because of their pertinence to the program. (Contractor's abstract)

2704

Technion - Israel Inst. of Tech., Haifa.

PLASTIC YIELDING IN ANELASTICITY, by M. Reiner. [1960] [7]p. incl. diagr. [AF 61(052)10] Unclassified

Published in Jour. Mech. and Phys. Solids, v. 8: 255-261, Nov. 1960.

By means of the application of a yield criterion, according to which yielding takes place when that part of the stress-work which is conserved reaches a definite maximum value, it is shown that from the constitutive equation of anelasticity 2 phenomena follow. On one hand, when the load is constant, yielding can take place after some time in creep. On the other hand, when a constant rate of strain is applied, the yield stress increases with the rate of strain. (Contractor's abstract)

2705

Technion - Israel Inst. of Tech., Haifa.

ON THE EXTPEMA OF THE FREQUENCIES OF NON-HOMOGENEOUS STRINGS WITH EQUIMEASURABLE DENSITY, by B. Schwarz. Dec. 1959, 42p. incl. diagrs. (Technical scientific note no. 2) (AFOSR-TN-60-281) (AF 61(052)194) AD 234519; PB 146424 Unclassified

Also published in Jour. Math. and Mech., v. 10: 401-422, May 1961.

Let $p(x)$ be positive and piecewise continuous in $[0, L]$, $0 < L < \infty$. Let $p_n^+(x)$ be its symmetrically increasing (decreasing) rearrangement of n^{th} degree ($n = 1, 2, \ldots$); i.e., $p_n^+(x)$ ($p_n^-(x)$) is equimeasurable to $p(x)$, is of period L/n, and is symmetrically increasing (decreasing) in

each period $[(k-1)L/n, kL/n]$, $k = 1, \ldots n$. Denote the n^{th} eigenvalue of the system $y''(x) + \lambda p(x)y(x) = 0$, $y(0) = y(L) = 0$, by $\lambda_n(p)$. The main result of this paper is (1) $\lambda_n(p_n^-) \leq \lambda_n(p) \leq \lambda_n(p_n^+)$, $n = 1, 2, \ldots$. It is also shown that

$$\lambda_1(p_1^-) \leq \frac{\pi^2}{L \int_0^L p(x)dx} \leq \frac{\pi^2}{(\int_0^L \sqrt{p(x)}dx)^2} \leq \lambda_1(p_1^+).$$

A new proof is given for a certain related result of M. G. Krein. The analogues of (1) for systems corresponding to nonhomogeneous strings with free ends and with one free and one fixed end are given. (Contractor's abstract)

2706

Technion - Israel Inst. of Tech., Haifa.

EIGENVALUE PROBLEMS OF NONHOMOGENEOUS STRINGS, by B. Schwarz. Final technical rept. Jan. 1960, 3p. (AFOSR-TR-60-57) (AF 61(052)194) AD 236524; PB 147107 Unclassified

This research is divided into 2 parts which were contained in 2 technical notes: (1) item no. 2070, Vol. III and (2) item no. 2705, Vol. IV. Only the abstracts of the 2 technical notes are given in the present report.

2707

Technion - Israel Inst. of Tech., Haifa.

RESEARCH ON CROSS-STRESSES IN THE FLOW OF LIQUIDS. PART I. CROSS-STRESSES IN THE LAMINAR FLOW OF LIQUIDS. PART II. CENTRIPETAL AIR-PUMP OPERATED ELECTROMAGNETICALLY, by M. Reiner. Technical rept. Mar. 1, 1959-Feb. 29, 1960 [22]p. incl. illus. diagrs. tables. (AFOSR-TN-60-996) (AF 61(052)223) AD 242271; PB 150357 Unclassified

Part I also published in Phys. Fluids, v. 3: 427-432, May-June 1960.

Part II also published in Brit. Jour. Appl. Phys., v. 10: 54-55, Jan. 1959.

Part I. Cross-elasticity effects exist in a simple homogeneous liquid such as toluene. These effects manifest themselves in cross-stresses observed in an instrument consisting of two circular metal plates, one stationary, the other rotating opposite it. The stator can be displaced along the axis of rotation against forces exerted by springs. Stator and rotor are in contact when at rest. When the rotor is brought into rotation, cross-stresses in the liquid separate stator from rotor and a bearing effect is produced. Part II. An instrument has been constructed to show that during the shearing of gas (air) a cross-pressure is developed and that the air moves centripetally towards the center.

2708

Technion - Israel Inst. of Tech., Haifa.

THE STRESS-STRAIN-RELATION OF ELASTICITY AND THE MEASURE OF STRAIN, by M. Reiner. Sept. 1960 [6]p. (Bound with its AFOSR-44; AD 258433) (AF 61-(052)223) Unclassified

Also published in Zeitschr. Angew. Math. und Mech., v. 40: 415-420, Sept. 1960.

The stress-strain relation of elasticity which is independent of the measure of strain contains the strain tensor in zero, first and second order and an infinite number of scalar parameters. When the displacement gradient is infinitesimal, the relation is reduced to s_{ik} $(\lambda I + \delta II)$ $\delta_{ik} + 2\mu\epsilon_{ik} + 4\mu_c\epsilon_{i\alpha}\epsilon_{\alpha k}$ with the four constant scalar material parameters λ, δ, μ and μ_c. When, as in classical elasticity, the parameters δ and μ_c are assumed to vanish, the elastic behavior of some material can only be adequately described by introducing a specific measure of strain ϵ_{ik}, which can be considered as the "natural" measure of the material. (Contractor's abstract)

2709

Technion - Israel Inst. of Tech., Haifa.

MEASURES OF DEFORMATION IN THE STRAINED AND IN THE UNSTRAINED STATE, by Z. Karni and M. Reiner. Oct. 1960 [4]p. (Bound with its AFOSR-44; AD 258433) (AF 61(052)223) Unclassified

Also published in Bull. Research Council Israel, v. 8C: 89-92, Oct. 1960.

Expressions for the Green-measure of deformation in the strained state and of the Almansi-measure of deformation in the unstrained state are derived. (Contractor's abstract)

2710

Technion - Israel Inst. of Tech., Haifa.

ON ROTATIONAL SUPERSONIC FLOW PAST THICK AIRFOILS - TABLES, by A. Kogan and A. A. Betser. Final technical rept. June 1960, 75p. incl. diagr. tables. (AFOSR-TR-60-135) (AF 61(052)281) AD 244457; PB 152479 Unclassified

Certain shock wave parameters, which appear in the calculation of pressure distribution on airfoils in a supersonic rotational flow, are presented in tabular form. The method underlying the use of the tables is summarized and discussed. A numerical example is worked out in detail, illustrating the procedure to be followed in the application of the tables. (Contractor's abstract)

2711

Technion - Israel Inst. of Tech. [Dept. of Aeronautical Engineering] Haifa.

THE EFFECT OF AXIAL CONSTRAINT ON THE INSTABILITY OF THIN CIRCULAR CYLINDRICAL SHELLS UNDER EXTERNAL PRESSURE, by J. Singer. Sept. 1959 [20]p. incl. diagrs. table. (Technical note no. 1) (AFOSR-TN-60-165) (AF 61(052)123)
AD 232083 Unclassified

Also published in Jour. Appl. Mech., v. 27: 737-739, Dec. 1960.

The effect of axial elastic restraint on the instability of a circular cylindrical shell under hydrostatic pressure, or under uniform lateral pressure, is analyzed by a Rayleigh-Ritz approach. For the case of hydrostatic pressure the effect is calculated for a wide range of parameters and design curves are presented for the % increase in critical pressure. The analysis is conducted for restraints which are active from the beginning of loading and for those which come into action only at the onset of buckling; the difference between these 2 types of restraint is shown to be very small.

2712

Technion - Israel Inst. of Tech. [Dept. of Aeronautical Engineering] Haifa.

BUCKLING OF CIRCULAR CONICAL SHELLS UNDER EXTERNAL PRESSURE, by N. J. Hoff and J. Singer. [1959] [26]p. incl. diagrs. refs. (AFOSR-3511) (AF 61(052)123) Unclassified

Also published in Proc. Symposium on Theory of Thin Elastic Shells, Delft (The Netherlands) (Aug. 24-28, 1959), Amsterdam, North-Holland Publishing Co., 1960, p. 389-414.

The equations of the non-axially symmetric deformations of conical shells presented earlier are made slightly more accurate through introduction of more complete expressions for the curvatures. At the same time their scope is extended to include problems of elastic stability. The stability equations are solved for loading under lateral and under hydrostatic pressure in the presence of slightly relaxed boundary conditions for the u and v displacements; for the w (radial) displacements the usual conditions of simple support are enforced rigorously. The results are presented in a parametric form analogous to that used by Seide for circular cylindrical shells, which yields convenient design curves, and are compared with results of earlier methods of solution. The present solution, as well as the basic equations, are valid for short thin shells having small cone angles which buckle with a large number of circumferential waves. (Contractor's abstract)

2713

Technion - Israel Inst. of Tech. [Dept. of Aeronautical Engineering] Haifa.

BUCKLING OF CIRCULAR CONICAL SHELLS UNDER AXISYMMETRIC EXTERNAL PRESSURE, by J. Singer. Nov. 1960 [29]p. incl. diagrs. tables. (Technical note no. 1) (AFOSR-TN-60-711) (AF 61(052)339)
AD 262194 Unclassified

Also published in Jour. Mech. Eng. Sci., v. 3: 330-339, Dec. 1961.

The stability equations for thin conical shells derived by Seide (Jour. Appl. Mech., v. 24: 547, Dec. 1957) are solved for loading under hydrostatic pressure and lateral pressure varying in the axial direction. The solution implies slightly relaxed boundary conditions for the u and v displacements, but for the w displacements the usual conditions of simple supports are enforced rigorously. The stability equation in the radial direction is rederived in a modified form similar to that given by Batdorf (NACA Rept. no. 874, 1947) for cylindrical shells and is solved by the Galerkin method. Results for the case of hydrostatic pressure loading are compared with those obtained by Hoff (item no. 2069, Vol. III) in an analysis restricted to small cone angles, and with the results found by other investigators. (Contractor's abstract)

2714

Technion - Israel Inst. of Tech. [Dept. of Aeronautical Engineering] Haifa.

THE EFFECT OF AXIAL CONSTRAINT ON THE INSTABILITY OF THIN CONICAL SHELLS UNDER EXTERNAL PRESSURE, by J. Singer. Dec. 1960 [14]p. incl. diagrs. (Technical note no. 2) (AFOSR-TN-60-860) (AF 61(052)339) AD 258356 Unclassified

Also published in Jour. Appl. Mech., v. 29: 212-214, Mar. 1962.

The effect of axial elastic restraint in the direction of the generators on the instability of a thin circular conical shell under hydrostatic pressure, or under uniform lateral pressure, is analysed by a Rayleigh-Ritz approach. For the case of hydrostatic pressure, the effect is calculated for a wide range of parameters and design curves are presented for the percentage increase in critical pressure. (Contractor's abstract)

2715

Technion - Israel Inst. of Tech. [Dept. of Mathematics] Haifa.

INTEGRAL TRANSFORMS WITH TWO REPRODUCING PROPERTIES, by J. Steinberg. Final rept. Oct. 1959 [54]p. (AFOSR-TR-60-13) (AF 61(052)192)
AD 232499; PB 146096 Unclassified

Also published in Bull. Research Council Israel, v. 8F: 195-214, Apr. 1960.

A constructive definition is given of the integral transforms J whose kernel depends on a real parameter $b > 1$, and possess the 2 properties: (1) $Jp = p$, for every polynomial p, and for each fixed $b > 1$; and (2) $Jf \to f$, when $b \to 1 + 0$, for every function f which is regular in a strip containing the real axis and which decreases exponentially at infinity. A new type of expansion of functions regular in an angle is considered. The type of expansion arises from the J-transforms. Elementary eigenfunctions of Weierstrass' singular integral are studied. Every non-zero real number is an eigenvalue of infinite multiplicity. (Contractor's abstract, modified)

2716

Technion - Israel Inst. of Tech. [Dept. of Mathematics] Haifa.

CLASSES OF BIORTHONORMAL SYSTEMS, by J. Steinberg. Oct. 1960, 56p. incl. refs. (Annual summary rept. no. 1) (AFOSR-TN-60-1489) (AF 61(052)-324) AD 254328 Unclassified

Also published in Ann. Mat. Pura et Appl., v. 52: 183-218, 1960.

In the biorthonormality relations $\int p_m(t)\, q_n(t)\, dt = \delta_{mn}$, the sequence $p_n(t)$ is an Appell set of polynomials, and $q_n(t) = (-1)^n q^{(n)}(t)$. Conditions on 1 sequence are given for the existence of the other, in 2 cases for the path of integration, (the real axis and a circle about the origin). A Fourier expansion theory is developed in these 2 cases by means of summability methods. As a consequence the completeness of a sequence of derivatives in $L_2(-\infty, \infty)$ is demonstrated. The connection with a class of integral equations is also explained. (Contractor's abstract)

2717

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

GRAVITATIONAL RADIATION, by A. Peres. [1959] [17]p. incl. refs. [AF 61(052)428] Unclassified

Published in Nuovo Cimento, Series X, v. 15: 351-369, Feb. 1, 1960.

Einstein's equations for a system of freely gravitating pole particles are solved by a method of successive approximations. In order to calculate the radiation rate it must be insured that there be no external radiation field. This condition poses a difficult problem since the relevant equations are non-linear. A solution is proposed which uniquely specifies the field up to the seventh order (radiation occurs first in the fifth order). The resulting radiation rate is the same as that given by the linearized theory, in the case of two particles revolving on circular orbitals. (Math. Rev. abstract, modified)

2718

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

QUANTUM LIMITATIONS ON THE MEASUREMENT OF GRAVITATIONAL FIELDS, by A. Peres and N. Rosen. [1959] [2]p. [AF 61(052)428] Unclassified

Published in Phys. Rev., v. 118: 335-336, Apr. 1, 1960.

By means of the analogy that exists between the gravitational field, in the weak, quasi-static case, and the electromagnetic field, uncertainty relations are obtained for the average values of some of the Christoffel symbols measured in 2 domains, similar to those for the components of the quantized electromagnetic field. Furthermore, it is shown that there exists a limitation on the accuracy to which the average value of a single 1 of these Christoffel symbols can be measured. The existence of uncertainty relations provides an argument in support of the standpoint that the gravitational field must be quantized. (Contractor's abstract)

2719

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

NULL ELECTROMAGNETIC FIELDS IN GENERAL RELATIVITY THEORY, by A. Peres. [1959] [6]p. incl. refs. [AF 61(052)428] Unclassified

Published in Phys. Rev., v. 118: 1105-1110, May 15, 1960.

Two solutions of the Maxwell-Einstein equations, representing null electromagnetic fields and corresponding to unidirectional radiation flow are constructed and investigated. One of these fields is coupled with transverse plane gravitational waves and the other 1 with longitudinal (not necessarily plane) gravitational waves. It is shown that not only the 2 electromagnetic invariants, but also the 14 invariants of the Riemann tensor vanish. (Contractor's abstract)

2720

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

INVARIANTS OF GENERAL RELATIVITY, I. CANONICAL FORMALISM, by A. Peres. [1960] [4]p. incl. refs. [AF 61(052)428] Unclassified

Published in Nuovo Cimento, Series X, v. 18: 32-35, Oct. 1, 1960.

It is shown that, if the Einstein equations are satisfied, the gravitational field invariants must be functions of the Dirac canonical variables only. It is further shown that the non-canonical variables $g_{o\mu}$ can be explicitly expressed as functions of the canonical ones (and their first time derivatives) and therefore can be eliminated from the Einstein equations. (Contractor's abstract)

2721

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

INVARIANTS OF GENERAL RELATIVITY. II. CLASSIFICATION OF SPACES, by A. Peres. [1960] [12]p. incl. refs. [AF 61(052)428] Unclassified

Published in Nuovo Cimento, Series X, v. 18: 36-47, Oct. 1, 1960.

Petrov's classification of pure gravitational fields is generalized to the case where matter is present. It is shown how the Petrov invariants can be computed directly, i.e. without the intermediate stage of quasi-Galilean coordinates (or tetrads, or spinors) that was required in previous works. It is further shown that if some of the invariants of Gêhêniau and Debever vanish, it is sometimes possible to find new algebraic invariants of the Riemann tensor, which are independent of those of Gêhêniau and Debever. This fact is especially interesting when all the Gêhêniau-Debever invariants vanish, as is shown by an example. (Contractor's abstract)

2722

Technion - Israel Inst. of Tech. [Dept. of Physics] Haifa.

COVARIANT FORMALISM FOR PARTICLE DYNAMICS, by A. Peres and N. Rosen. [1960] [7]p. [AF 61(052)-428] Unclassified

Published in Nuovo Cimento, Series X, v. 18: 644-650, Nov. 16, 1960.

In the usual covariant formulations of particle dynamics difficulties are encountered that appear to be associated with constraint imposed of the 4-velocity, $u_k u^k = 1$. It is proposed to remove these difficulties by putting the Lagrangian into a suitable form, so that this condition on the velocities is a consequence of equations of motion together with appropriate initial conditions, rather than a constraint. (Contractor's abstract)

2723

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

GRAVITATIONAL RADIATION DAMPING OF NON-GRAVITATIONAL MOTION, by A. Peres and N. Rosen. [1959] [6]p. incl. refs. [AF 61(052)428] Unclassified

Published in Ann. Phys., v. 10: 94-99, 1960.

The rate of working of non-gravitational forces in a material system is defined. It is shown that in linearized gravitation theory this rate equals the rates at which gravitational energy is radiated. (Math. Rev. abstract)

2724

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

STATISTICAL DISTRIBUTION OF THE MAGNETIC MICROFIELD IN A PLASMA, by G. Kalman. [1960] [2]p. [AF 61(052)428] Unclassified

Published in Phys. Fluids, v. 4: 300-301, Mar. 1961.

The static magnetic field due to randomly distributed charged particles in phase space is investigated. A Holtsmark-like distribution is derived, centered around $2.0091\ B_0$, the latter being the magnetic field caused by a particle moving with the average velocity at an average interparticle distance.

2725

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

NONLINEAR ELECTRODYNAMICS IN GENERAL RELATIVITY, by A. Peres. [1960] [2]p. incl. refs. [AF 61(052)428] Unclassified

Published in Phys. Rev., v. 122: 273-274, Apr. 1, 1961.

General relativistic field equations are derived from a gauge-invariant electromagnetic Lagrangian, which does not involve derivatives of the field, nor any charge density, but otherwise is completely arbitrary. These equations are explicitly solved in the static spherically symmetric case, and it is shown that there are solutions which are everywhere regular and behave, at large distances, like the gravitational and electromagnetic fields of a point charge. Some wave-like solutions are also derived. (Contractor's abstract)

2726

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

GAUGE COVARIANCE OF SPINOR GEOMETRY, by A. Peres. [1960] [2]p. [AF 61(052)428] Unclassified

Published in Nuovo Cimento, Series X, v. 21: 182-183, July 1961.

Some results of Bergmann concerning the covariant derivative of the alternating spinor ϵ_{mn} are discussed. Assuming $T_{m'}{}^{n}$ to be the transformation matrix between 2 spinor frames, by employing the Dirac equations $g^{\mu\dot{m}n}\psi_{n;\mu} = -k\epsilon^{\dot{m}h}\varphi_n$ and $g^{\mu\dot{m}n}\varphi_{m;\mu} = k\epsilon^{mn}\psi_m$, and by utilizing the covariant derivatives of the pseudospinor ψ_m; it is implied that a_μ (a-vector) is only partially determined by the electromagnetic potential.

2727

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

ON GEOMETRODYNAMICS AND NULL FIELDS, by A. Peres. [1960] [21]p. incl. refs. [AF 61(052)428] Unclassified

Published in Ann. Phys., v. 14: 419-439, July 1961.

The possibility of describing null electromagnetic fields by purely metric concepts has recently been subject to some doubt. Following a method devised by Hlavaty, the relation that a Riemannian manifold must satisfy in order to correspond to a null electromagnetic field is investigated. It is shown that in most cases the fulfilment of 5 geometrical relations is a necessary and sufficient condition for the existence of a null electromagnetic field. The latter is unique, except for an arbitrary constant phase factor (as in the case of non-null fields). However, in some exceptional cases, there is a large degree of arbitrariness in the null electromagnetic field that corresponds to a given metric. Some fields (which always possess wave fronts) are not reducible to metric concepts. An examination is made on how it can occur that null electromagnetic fields require the fulfilment of 5 relations, rather than 3 as non-null ones. In order to settle this question, an attempt is made to consider null fields as a limiting case of non-null ones, by superimposing an arbitrary infinitesimal non-null field on a finite null one. It is then shown that the Rainich vector of such a field does not have a well defined limit, when the perturbing non-null field tends to zero. It is thereby inferred that null electromagnetic fields really have a special status within the frame of geometrodynamics. (Contractor's abstract)

2728

Technion - Israel Inst. of Tech. Dept. of Physics, Haifa.

ELECTROMAGNETIC RADIATION FROM A FREELY GRAVITATING CHARGE, by A. Peres. [1960] [5]p. [AF 61(052)428] Unclassified

It is shown that a charge, accelerated by a gravitational field, radiates as if it were accelerated by any other external force. General relativistic effects appear only as corrections, which can be neglected for slow motions in weak fields. The bearing of this fact upon the equivalence principle is discussed in relation to a recent paper of DeWitt and Brehme. (Contractor's abstract)

2729

Technische Hochschule. Inst. für Angewandte Mathematik, Karlsruhe (Germany).

THEORETICAL INVESTIGATIONS ON RING AIRFOILS, by J. Weissinger. Jan. 1960 [113]p. incl. diagrs. tables, refs. (AFOSR-TN-60-343) (AF 61(514)1207) AD 234517; PB 146435 Unclassified

The effects of interference between a ring airfoil and a slender central body are studied. Simple formulas for the lift and the pitching moment are derived from a more thorough theory by considerations taken from lifting line and three quarter point theory. Numerical results are given for ellipsoidal bodies. Two methods for computing the 3-dimensional laminar boundary layer on ring airfoils are developed. The 1st is based on an expansion with respect to the angle of attack, the 2nd is an iteration procedure. In both methods a von Kármán-Pohlhausen procedure is used. The wall streamlines and the separation line are shown. (Contractor's abstract)

2730

Technische Hochschule. Inst. für Theoretische Elektrotechnik, Karlsruhe (Germany).

MECHANICAL AND ELECTRICAL PHENOMENA OF THE HEART ACTION, by W. Ernsthausen and W. von Wittern. Final rept. Mar. 1960, 42p. incl. illus. diagrs. refs. (AFOSR-TR-60-134) (AF 61(514)1063) AD 246210; PB 153037 Unclassified

The report covers the electromechanics of the heart. A new method for the simultaneous recording of motion and voltage between 2 points on the heart's surface is described. Measurements on dog hearts recorded with this method under various conditions are reported. (Contractor's abstract)

2731

Technische Hochschule, Munich (Germany).

[THE EFFECT OF MONOIODACETIC ACID ON THE RESPIRATION AND PHOTOSYNTHESIS OF CHLORELLA] Die Wirkung von Monojodessigäure auf Atmung und Photosynthese von Chlorella, by V. O. Kandler, I. Leisenkötter, and B. A. Oaks. [1960] [12]p. incl. diagrs. tables, refs. (AFOSR-1509) (AF 61(052)244) AD 612243 Unclassified

Also published in Zeitschr. Naturforsch., v. 16: 50-61, 1961.

Results show that triosephosphate dehydrogenase is the most sensitive enzyme in Chlorella. Monoiodacetic acid (MIA) leads to a large accumulation of fructose diphosphate (FDP) and a large decrease in phosphoglyceric acid (PGA). Also, the breaking down of glucose via 6-phosphogluconate is inhibited by MIA. FDP builds up during MIA poisoning in the dark and is quickly transformed to ribulose diphosphate (RuDP), in the light; subsequently, RuDP is transformed to PGA and its derivatives (pyruvate and other acids) by carboxylation and hydrolysis of the ketoacid. The photosynthetic CO_2 assimilation of Chlorella is about 100 fold more sensitive toward MIA than respiration. It is found that the reduction of the fixed CO_2 is the most sensitive reaction of photosynthesis in Chlorella. (Contractor's abstract)

2732

Technische Hochschule. Mathematical Inst., Munich (Germany).

PROJECTILE AEROBALLISTICS, by R. Sauer. [1959] [8]p. [AF 61(514)1080] Unclassified

Published in AGARD-Tagung über Ballistik, Pergamon Press, N. Y., 1959, p. 117-124.

Linearized theory of steady supersonic flow past projectiles without wings at zero incidence is briefly reviewed. Numerical calculation of exact solutions and the slender body approximation are discussed. Analogous methods are dealt with for projectiles at incidence and for winged projectiles; thereafter the wing body interaction problem and the area rule are treated. Linear methods for computing the unsteady flow past oscillating projectiles and non-linear methods (theory of characteristics) for computing the flow field between the projectile and the attached and detached shock in front of the nose of the projectile are reported. (Contractor's abstract)

2733

Technische Hochschule. Mathematical Inst., Munich (Germany).

NUMERICAL INVESTIGATIONS ON THE SOLUTION OF THE NON-LINEAR EQUATION OF SUPERSONIC FLOW BY FINITE DIFFERENCE METHODS (PART I), by G. Seegmüller. Nov. 4, 1959, 45p. incl. diagrs. tables, refs. (Technical note no. 10) (AFOSR-TN-60-255) (AF 61(514)1080) AD 233375; PB 145856 Unclassified

The method of characteristics in supersonic flow is treated by the numerical way of the mean-value approximation in several variations. Information is given on the type of convergence and on the truncation error in the local case and in the large, when solving the difference equations by iteration. Pure mean-value procedures are described which also converge on the axis of flows with cylindrical symmetry. Finding the "true solution" by extrapolation is discussed.

2734

Technische Hochschule. Mathematical Inst., Munich (Germany).

A NUMERICAL APPROACH TO THE QUESTION OF STABILITY OF SUPERSONIC ENCLOSURES IN AN OTHERWISE SUBSONIC FLOW FIELD, by W. Werner. Dec. 7, 1959 [35]p. incl. diagrs. (Technical note no. 12) (AFOSR-TN-60-256) (AF 61(514)1080) AD 233376; PB 145855 Unclassified

A numerical investigation of stability of transonic flows past a profile is given. An "exceptional" solution is calculated describing a steady, continuous transonic flow. The solution is used as initial data for a time dependent numerical calculation. The result indicates that steady solutions of the system exist for which shocks occur in the vicinity of the sonic line of the continuous sonic flow. Graphical representations of the numerical data are given.

2735

Technische Hochschule. [Mathematical Inst.] Munich (Germany).

PRACTICAL NUMERICAL METHODS OF THREE-DIMENSIONAL SUPERSONIC FLOW, by R. Sauer. Final technical rept. Mar. 1, 1960, 32p. incl. diagrs. (AFOSR-TR-60-40) (AF 61(514)1080) AD 240366 Unclassified

Contributions to practical numerical methods for 3-dimensional supersonic flows were made within several special fields only loosely related to each other. These contributions pertain to linear supersonic flow past slender bodies of arbitrary shape, past wing-body combinations and past oscillating bodies, investigations on the area rule in supersonic flow, problems of 2-dimensional unsteady, non-linear flow, and investigations on numerical methods for the equations of supersonic flow. Twelve technical notes are summarized by this report; for the individual notes see item nos. THM. 03:001-006, Vol. II, item nos. 2088-2091, Vol. III, and item nos. 2725 and 2726, Vol. IV.

2736

Technische Hochschule. [Mathematical Inst.] Munich (Germany).

[SUPERSONIC FLOW OF AN OSCILLATING BODY OF REVOLUTION] Überschallströmungen um pendelnde Drehkörper, by V. J. Münch. [1959] [6]p. incl. diagrs. [AF 61(052)377] Unclassified

Published in Zeitschr. Angew. Math. und Mech., v. 40: 328-333, July/Aug. 1960.

A source-sink method is given for determining the surface pressure on solids of rotational symmetry oscillating in a supersonic field with arbitrary frequency. Such a method is suitable for electronic computers.

2737

Technische Hochschule. Mathematical Inst., Munich (Germany).

NUMERICAL INVESTIGATIONS ON THE SOLUTION OF THE NON-LINEAR EQUATION OF SUPERSONIC FLOW BY FINITE DIFFERENCE METHODS (PART II), by G. Seegmüller. July 25, 1960, 29p. incl. diagrs. tables. (Technical note no. 1) (AFOSR-TN-60-1141) (AF 61-(052)377) AD 244465 Unclassified

A proof is given of a theorem which establishes the local existence and uniqueness of the solution of the difference equations resulting from a mean-value approximation (see item no. 2733, Vol. IV) and secures the convergence of a certain NEWTON-sequence. Information is

given on finding the true solution by extrapolation on a sounder basis. A discussion on streamline-integration is also included. Numerical illustrations of some questions are also added. (Contractor's abstract)

2738

Technische Hochschule. [Mathematical Inst.] Munich Germany).

RIEMANN'S PROBLEM FOR A LAVAL NOZZLE. PART II. TWO-DIMENSIONAL TREATMENT, by R. Schätz. Dec. 20, 1960 [34]p. incl. diagrs. tables. (Technical note no. 2) (AFOSR-415) (AF 61(052)377) AD 255006 Unclassified

This is part 2 of an investigation of the accuracy of the hydraulic approximations of nozzle flow. Results pertaining to Riemann's problem for a Laval nozzle were presented in part 1 (see item no. 2090, Vol. III). The results are compared here with the solution of the same problem as obtained by the 2-dimensional method suggested by Bruhn and Haack. Satisfactory agreement is found.

2739

Technische Hochschule, Vienna (Austria).

CONDUCT THEORETICAL RESEARCH ON THE STRENGTH OF VORTICES PRODUCED BEHIND A SHOCK WAVE IN THE BOUNDARY LAYER FOR SUPERSONIC FLOW, by R. Bruniak. Final technical rept. [1960] 11p. tables. (AFOSR-TR-60-18) (AF 61-(052)78) AD 232069; PB 146710 Unclassified

Investigation is made of the vortices appearing behind a shock wave in the boundary layer relative to their strength and their influence on the thickness of the boundary layer. The Crocco vortex-law, in its general form, is used to find the strength of a vortex.

2740

[Technische Hochschule] Vienna (Austria).

ELASTIC THERMAL STRESSES IN DELTA WINGS. PART I, by H. Parkus. July 15, 1960, 1v. incl. diagrs. tables, refs. (AFOSR-TR-60-140) (AF 61-(052)214) AD 244513 Unclassified

Due to aerodynamic heating, wings of fast-flying aircraft are subject to considerable temperature rise and, in consequence, to high thermal stresses. The problem has received much attention in recent years. It is the purpose of this paper to extend these investigations to wings of triangular form (delta wings). The wings are assumed to be constructed of either triangular plates or shallow conical shells. The temperature distribution is assumed to be known. It may be calculated from the flight program in the usual manner. (Contractor's abstract)

2741

Temple U. Research Inst., Philadelphia, Pa.

THE DENSITY OF MOLTEN METAL FLUORIDES IN THE RANGE OF 1600°-2500°K, by A. D. Kirshenbaum, J. A. Cahill, and C. S. Stokes. [1959] [8]p. incl. diagrs. tables. [AF 18(600)1475] Unclassified

Presented at meeting of the Amer. Chem. Soc., High Temperature Session of Div. of Industrial and Engineering Chemistry, Boston, Mass., Apr. 1959.

Published in Jour. Inorg. and Nuclear Chem., v. 15: 297-304, Oct. 1960.

Using a graphite crucible and a tungsten sinker, the liquid densities of the alkaline earth and the 2 rare-earth fluorides were determined by the immersed-sinker method, over a temperature range of 1600°-2500°K. The molar volumes and thermal coefficients of expansion were calculated from the liquid densities and were correlated with those of the alkali-metal fluorides. The liquid-molar volumes of the alkaline earth fluorides exhibit a linear relationship when plotted against the period in the Periodic Table. (Contractor's abstract)

2742

[Texaco] Experiment, Inc. [Richmond, Va.]

PROPERTIES OF IONS IN FLAMES (Abstract), by I. R. King. [1960] [1]p. (Bound with its AFOSR-TN-60-405; AD 235949) (AF 49(638)650) Unclassified

Presented at Third AFOSR Contractors' meeting on Ion and Plasma Propulsion, Republic Aviation Corp., Farmingdale, N. Y., Mar. 22-24, 1960.

The research being conducted is concerned with the recombination of gaseous ions at high temperatures (1500-2200°K) and the mechanism involved. Experimental data, obtained with both natural flame ions and alkali metal ions introduced into the flame, are compared with theoretical predictions based on existing theories. No satisfactory agreement between theory and experiment has been found. Measurements of recombination rates indicate an ion-ion type recombination for natural flame ions and an ion-electron process in flames containing a preponderance of alkali metal ions. In all cases, the recombination process follows a second-order law.

2743

[Texaco] Experiment, Inc., Richmond, Va.

PROPERTIES OF IONS IN FLAMES (Abstract), by I. R. King. [1960] [1]p. (AF 49(638)650) Unclassified

Presented at Fourth Contractors' meeting on Airbreathing Combustion, California U., Berkeley, May 16-17, 1960. (AFOSR-TN-60-1253; AD 247033)

Results of experiments concerned with the recombination of gaseous ions at high temperatures (1500-2200°K) and the mechanism involved therein are compared with

theoretical predictions based on existing theories and found not to be of satisfactory agreement. Measurements of recombination rates indicate an ion-ion type recombination for natural flame ions and an ion-electron process in flames containing a preponderance of alkali metal ions. In all cases, the recombination process follows a second-order law. The rate of recombination of natural flame ions has been found to increase with increasing temperature and to decrease with increasing pressure. Alkali metal ions show very little if any dependence on pressure and a rather rapid decrease in recombination rate as temperature increases from 1740 to 1900°K. Slight traces of halogens or other electron-attaching species cause a drastic reduction in the recombination rate.

2744

Texas A. and M. Coll. [Dept. of Physics] College Station.

CONCENTRATION DEPENDENCE OF NMR SPIN-LATTICE RELAXATION TIMES IN SOLUTIONS, by R. W. Mitchell and M. Eisner. [1960] [4]p. incl. diagrs. table. (AFOSR-TN-60-895) (AF 18(600)1300) AD 256735 Unclassified

Also published in Jour. Chem. Phys., v. 34: 651-654, Feb. 1961.

Spin-lattice relaxation times for protons in benzene, cyclohexane, chlorobenzene, bromobenzene, and o-dichlorobenzene in solution with carbon tetrachloride and carbon disulfide are empirically fitted to theoretical curves based on the Hill and molecular sphere models of molecular motion. The results indicate that the Hill model properly accounts for the variation of both the rotational and translational relaxation times with concentration of solute. (Contractor's abstract)

2745

Texas A. and M. Coll. [Dept. of Physics] College Station.

STUDY OF THE PHYSICAL ANOMALIES OF BINARY SOLUTIONS USING NUCLEAR MAGNETIC RESONANCE, by M. Eisner. Interim final rept. Oct. 12, 1960, 6p. (AFOSR-TR-60-143) (AF 18(600)1300) AD 247617 Unclassified

In applying NMR (nuclear magnetic resonance) techniques to the study of physical anomalies of binary solutions, it is first necessary to develop a treatment for non-anomalous behavior. A formulation of the relation between the NMR relaxation times and physical properties of the solutions was obtained which was tested experimentally and was found to be in satisfactory agreement with the experiment. Deviations from the results of this model are interpreted in terms of microscopic anomalies which are reflected in the physical properties. (Contractor's abstract)

2746

Texas A and M. Coll. [Dept. of Physics] College Station.

NUCLEAR SPIN-LATTICE RELAXATION IN SOLUTIONS, by R. W. Mitchell and M. Eisner. [1960] [6]p. incl. diagrs. tables, refs. [AF 18(600)1300] Unclassified

Published in Jour. Chem. Phys., v. 33: 86-91, July 1960.

T_1 for protons in C_6H_5Cl, C_6H_6, and C_6H_{12} has been measured as a function of concentration in solution with CS_2 and CCl_4. T_1 does not have the dependence on the solution viscosity suggested by the theory of Debye. The rotational relaxation times at infinite dilution are obtained by extrapolation, and the correlation times calculated from these results are compared with the values predicted by the rotating sphere model as well as an inner viscosity and microviscosity model. The inner viscosity model provides the best agreement with the experimental results. The correlation times are found not to be proportional to the volumes of the molecules but seem to be simply related to the moments of inertia as well as the masses of the molecules of interest and the masses of the solvent molecules. An approximate formula which provides good results for the systems above is suggested as $\tau = 2I\eta\, a/\mu kT$, where I is the moment of inertia of the molecule of interest, η is the solvent viscosity, a is the average radius of the molecule, and μ is the reduced mass of the solvent-solute system. (Contractor's abstract)

2747

Texas Technological Coll. Dept. of Chemistry, Lubbock.

A CONTROLLED ATMOSPHERE THERMOBALANCE, by W. W. Wendlandt. [1960] 14p. incl. diagrs. refs. (AFOSR-334) (AF 49(638)787) AD 253138; PB 155304 Unclassified

Also published in Jour. Chem. Education, v. 38: 566-568, Nov. 1961.

One of the inherent problems of the quartz spiral type of balances is the fragility and limited load capacity of the spiral. To overcome this difficulty, an automatic recording balance has been constructed having a strain gauge as the weight-sensing transducer. The transducer has a range of ± 0.15 oz with a sensitivity of 20.93 mc/oz at 90 excitation voltage. The strain gauge can stand a 1 lb force overload without damage. The excitation voltage can be either ac or dc and it has a non-linearity plus hysteresis effect of less than ±1% of full scale. A diagrammatic representation of the apparatus is also given.

2748

[Texas U. Dept. of Chemistry Austin]

MECHANISMS OF NUCLEATION IN CARBON FORMATION, by F. C. Stehling, J. F. Frazee, and R. C.

Anderson. [1960] [11]p. incl. diagrs. tables, refs. (AFOSR-2497) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)142] and Petroleum Research Fund) Unclassified

Also published in Eighth Symposium (Internat'l.) on Combustion, California Inst. of Tech., Pasadena (Aug. 28-Sept. 3, 1960), Baltimore, Williams and Wilkins Co., 1962, p. 774-784. (AFOSR-TR-60-127)

The formation of solid particles in a fluid medium is normally a two-stage process, the first stage being the formation of nuclei and the second the growth, by deposition, of materials on these nuclei, to form the final particles. These experiments were undertaken to try and obtain further information about reactions involved in the nucleation process for various hydrocarbon systems. Simple pyrolysis was investigated using a quartz tube as a flow reactor. Acetylene, vinylacetylene, benzene, naphthalene, and 2-methylnaphthalene were studied. The chief gaseous products were hydrogen, methane, acetylene, ethylene, and benzene. The results indicate that at lower temperatures aromatic molecules can undergo condensation reactions without going through an intermediate such as acetylene. In flame systems, reaction may be initiated by oxygen or oxygenated radicals, as contrasted to thermal activation; but the main reactions in formation of nuclei must be much the same as for pyrolysis. These results also show why reaction systems can be so sensitive to the rate of heating and other physical conditions in the flame system. The trend of these and other data indicate finally, that at relatively high temperatures fragmentation of all carbon structures is important, and differences in the original hydrocarbons have a minimal influence.

2749

Texas U. [Dept. of Chemistry] Austin.

REPORT FROM COMBUSTION PROJECT AT THE UNIVERSITY OF TEXAS (Abstract), by F. A. Matsen. [1960] [1]p. (AF 18(603)142) Unclassified

Presented at First AFOSR Contractors' meeting on Chemical Kinetics of Propulsion, General Dynamics Corp., General Atomic Div., San Diego, Calif., Sept. 6-7, 1960. (AFOSR-TN-60-1063; AD 246174)

The specific reaction rate for the thermal decomposition of butane has been determined as a function of temperature in a flowing system. Assuming slug flow, the following equation applies: $\varphi = -((1 + \nu X_o) \ln f + \nu X_o(1 - f)) = k/S$ where f is the mole-ratio of unreacted reactant to initial reactant, $\nu + 1$ is the mole-ratio of products to reacted reactant, $X_o \rightarrow X_o$ is the initial mole fraction of reactant, S is the space velocity, and k is the first order rate constant. The product distribution from the butane decomposition is normal and unaffected by dilution with nitrogen or helium. A plot of φ vs 1/S extrapolates properly to zero at infinite flow rate. The preliminary rate constants obtained by this method are given by $\log k = 10.1 - 48000/2.3RT\ sec^{-1}$. While the magnitudes of the rate constants agree well with those obtained previously in static systems, the temperature dependence is considerably lower. The present status and future plans for study of the acetylene-ethylene oxide and of the alkyl-metal systems are also considered.

2750

Texas U. [Dept. of Physics] Austin.

[ENERGY LEVEL MEASUREMENTS BY NEUTRON SCATTERING EXPERIMENTS]. Final rept. Mar. 27, 1959-Sept. 30, 1960, 1v. incl. illus. diagrs. refs. (AFOSR-TR-60-161) (AF 33(038)20681) Unclassified

Report is made of investigations on the lifetimes of positronium (an electron and positron in a bound state), energy levels in light nuclei, and scattering experiments with neutrons. The work of the project is reviewed and related to general advances in physics over a 10 yr period. Reports from the various research groups working under the contract include the following subjects: (1) neutron experiments with the Cockcroft-Walton apparatus, (2) annihilation of positrons, (3) nuclear stripping reactions, (4) unbound levels in N^{15}, and (5) low temperature investigations. A list of theses and dissertations emanating from the research, as well as a list of publications and papers presented are appended.

2751

Texas U. Dept. of Physics, Austin.

HIGH PRESSURE SPECTROSCOPY, by W. W. Robertson. Technical rept. Nov. 1, 1956-Oct. 31, 1959, 17p. incl. refs. (AFOSR-TR-60-51) (AF 49(638)35) Unclassified

The effects were studied of hydrostatic pressure on the absorption spectra of non-polar aromatics in dilute solution of hydrocarbon solvents. Pressure changes up to those that produce solidification actually produced only small changes in the intermolecular forces. Spectra changes that are usually observed are those of intensity, breadth of band and frequency shift. Frequency shifts of the bands, however, remained as potentially the more profitable source of information about pressure shift, thus most of the investigation was directed to the measurement of frequency shifts.

2752

Texas U. Dept. of Physics, Austin.

COMPARISON OF THE EFFECTS OF HIGH PRESSURE AND LOW TEMPERATURE ON THE ABSORPTION SPECTRA OF SOME CONDENSED-RING AROMATICS, by W. W. Robertson. [1960] [4]p. incl. diagrs. table, refs. [AF 49(638)35] Unclassified

Published in Jour. Chem. Phys., v. 33: 362-365, Aug. 1960.

A comparison of the spectral shifts obtained by lowering the temperature of a solution to those obtained by increasing its hydrostatic pressure shows that the temperature shift is composed of two oppositely directed components. The larger one is the red shift due to solvent density increase with temperature decrease and the accompanying increase in dispersion forces. The second and usually smaller effect is a blue shift that results from a change in the shape of the band as a result of a decrease in the population of the higher vibrational levels with a decrease in temperature. (Contractor's abstract)

2753

Texas U. [Dept. of Physics] Austin.

EQUIVALENCE PRINCIPLE AND RED-SHIFT MEASUREMENTS, by A. Schild. [1960] [3]p. incl. refs. [AF 49(638)35] Unclassified

Published in Amer. Jour. Phys., v. 28: 778-780, Nov. 1960.

It is shown that experiments on accelerated systems deny the general theory of relativity. It is also demonstrated that the equivalence principle leads to the same gravitational red-shift as general relativity but does not lead to specific values for the bending of rays by a star or for the perihelion rotation of a planetary orbit. (Contractor's abstract, modified)

2754

Texas U. [Dept. of Physics] Austin.

THE INTERACTION OF A TRIPLET AND A NORMAL HELIUM ATOM, by G. H. Brigman, S. J. Brient, and F. A. Matsen. [1960] [10]p. incl. diagr. table, refs. (AFOSR-TN-60-954) (in cooperation with Convair, Ft. Worth, Texas) (AF 49(638)560) AD 249257 Unclassified

Also published in Jour. Chem. Phys., v. 34: 958-960, Mar. 1961.

The electronic energy of the system He(^{1}S) and He(^{3}S) was calculated as a function of nuclear separation. This calculation differs from an earlier one by R. A. Buckingham and A. Dalgarno (Proc. Roy. Soc. London, v. A213: 327, 1952) in 3 ways: (1) The use of a nodeless 2s function, (2) The use of an open-configuration wave-function (1s1s') for He(^{1}S), and (3) The use of orbital exponents optimized for each internuclear distance. The energy obtained lies approximately 1 v below the earlier calculation but confirms it in all qualitative aspects including the presence of a hump at R = $4a_o$. (Contractor's abstract)

2755

Texas U. [Dept. of Psychology] Austin.

DEFENSIVENESS AND SELF-ACCEPTANCE IN THE MANAGEMENT OF HOSTILITY, by D. J. Veldman and P. Worchel. [1960] [19]p. incl. tables, refs. (AFOSR-TN-60-1139) (AF 49(638)460) Unclassified

Also published in Jour. Abnorm. and Social Psychol., v. 63: 319-325, Sept. 1961.

On the basis of Self-Concept theory, 4 types of personalities are described based on the nature of the defenses employed in maintaining the self structure. Hypotheses concerning the management of hostility are derived from the interaction of varying degrees of self-ideal discrepancy and defensiveness. It is predicted that delay following the arousal of hostility produces a drop in feelings of anger but that negative attitudes would persist. Eighty undergraduate males from an introductory course in psychology are selected on the basis of high and low scores on a self-ideal inventory and the k-scale (defensiveness) of the MMPI. A delay (i. e. followed by a 20 min neutral task) and non-delay group are subjected to tests of hostility measures of direct anger, projective anger, examiner-blame, examiner-devaluation, displaced hostility, and aggression-anxiety. Results show that on hostile feelings, the interaction of self-ideal discrepancy and defensiveness was significant at the .05 level. On the expression of rational aggression toward the examiner, the triple interaction of delay x self-ideal x k-scale was significant at about the .05 level. There were no significant, main or interaction effects concerning irrational aggression. As predicted, the high self-ideal group displayed more hostility than the low self-ideal group.

2756

Texas U. [Dept. of Psychology] Austin.

ARBITRARINESS OF FRUSTRATION AND AGGRESSION, by J. J. Kregarman and P. Worchel. [1960] 15p. incl. tables, refs. (AFOSR-TN-60-1375) (AF 49(638)460) Unclassified

Also published in Jour. Abnorm. and Social Psychol., v. 63: 183-187, July 1961.

This study was conducted (a) to test the differential implications of 2 theoretical positions, namely, reduced level of drive or response-inhibition, in accounting for the reduction of aggression under nonarbitrary frustration, and (b) to isolate the influence of expectancy and reasonableness on the expression of aggression. Seventy-six male undergraduate students were given a bogus intelligence test under frustrating conditions. Following the test, measures were obtained of each subject's tendency to attack the frustrator, himself, and slightly negative stereotypes. Results indicated that (1) the expectation of a frustration reduces the tendency to express aggression toward the frustrator; (2) the reasonableness of a frustration does not seem to significantly affect the amount of aggression expressed toward the frustrator, but this may be due to the failure to sufficiently vary this dimension; and (3) both expectation of frustration and reasonableness of frustration increase the tendency to express aggression toward one's self. Of the 2 hypotheses, reduced level of drive vs response-inhibition in the reduction of aggression under

nonarbitrary frustrations, the latter is more tenable. Furthermore, the results suggest that under reasonable or justifiable frustrations, the subject himself may be perceived as the direct agent of frustration.

2757

Texas U. [Dept. of Psychology] Austin.

SOME EFFECTS OF SHARED THREAT AND PREJUDICE IN RACIALLY MIXED GROUPS, by E. Burnstein and A. V. McRae. [1960] 18p. incl. diagr. tables, refs. (AFOSR-TN-60-1376) (AF 49(638)460) Unclassified

Also published in Jour. Abnorm. and Social Psychol., v. 64: 257-263, Apr. 1962.

The purpose of the experiment is to test the relationship between shared threat and the expression of prejudice hypothesized by Geshbach and Singer (Jour. Abnorm. and Social Psychol., v. 54: 411-416, 1957). Forty-eight subjects, varying with respect to anti-Negro prejudice, are placed under conditions of shared threat or nonthreat, in task oriented, cooperative work groups. A Negro confederate was a member in each group. A reduction in the expression of prejudice occurs in terms of direct evaluation of the Negro under conditions of shared threat on a posttask questionnaire. However, significantly fewer messages are addressed to the Negro by the high prejudiced subjects, regardless of the presence or absence of shared threat. (Contractor's abstract, modified)

2758

Texas U. [Dept. of Psychology] Austin.

STATUS-RESTORATION AND THE REDUCTION OF HOSTILITY, by P. Worchel. [1960] 12p. incl. tables, refs. (AFOSR-TN-60-1446) (AF 49(638)460) Unclassified

Also published in Jour. Abnorm. and Social Psychol., v. 63: 443-445, Sept. 1961.

The present study reports positive results on a test of the implications of a threat theory of hostility, namely, that hostility is reduced by status-restoration. Essentially, the experiment deals with techniques designed to restore the status or the integrity of subjects, who have been subjected to the hostile-arousing conditions without permitting expression of aggression, i. e., catharsis or communication. (Contractor's abstract)

2759

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

IONIZATION IN ROCKET FLAMES, by J. Nichol, V. Siminski, and H. G. Wolhard. [1960] 13p. incl. diagrs. tables, refs. (AFOSR-TN-60-285) (AF 49(638)305) AD 236915; PB 147545 Unclassified

Also published in Eighth Symposium (Internat'l.) on Combustion, California Inst. of Tech., Pasadena (Aug. 28-Sept. 3, 1960) Baltimore, Williams and Wilkins Co., 1962, p. 235-241. (AFOSR-TR-60-127)

It is demonstrated that the measured ion concentrations in a "seeded" rocket combustion chamber may be predicted within an order of magnitude by a simple application of the Saha equation. In all cases the ion concentrations measured by the Langmuir probe are less than or equal to calculated values. No evidence of chemi-ionization was found in "seeded" flames, although it may be present in "pure" flames. In this latter case however the data are not conclusive because of the possible presence of minute quantities of impurities. The data suggest that the correlation will be improved if the chemical equilibria which control the alkali metal atom concentration are included in the calculations. At the present time, however, the necessary thermochemical data are not known to a sufficient degree of accuracy to justify more tedious calculations. Furthermore, even an order of magnitude estimate of the degree of ionization in a rocket flame is sufficient to evaluate the basic feasibility of certain magnetohydrodynamic applications which have been proposed for chemical rockets. (Contractor's abstract)

2760

Thiokol Chemical Corp. [Reaction Motors Div.] Denville, N. J.

RESEARCH ON THE INFLUENCE OF IONS ON ROCKET COMBUSTION (Abstract), by N. J. Socolowski. [1960] [1]p. (Bound with its AFOSR-TR-60-37) (AF 49(638)-305) Unclassified

Presented at Twelfth AFOSR Contractors' meeting on Liquid Propellant Rocket Combustion, Mar. 2-3, 1960.

The results of experimental and analytical studies on the effects of temperature, pressure, and O/F ratio on ion concentration in rocket combustion chambers are presented. The measured ion concentrations in rocket flames "seeded" with alkali metals agree within an order of magnitude with simple thermochemical calculations based on the Saha equation. It is shown that chemical equilibria which control the free alkali metal atom concentration in the flame gases must be considered to improve the agreement between theory and experiment. A discussion of theoretical and experimental studies on magnetohydrodynamic effects on rocket heat transfer is presented. It is shown that the degree of ionization is insufficient to obtain any practical reduction of heat transfer by this method for conventional chemical rocket systems.

2761

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

RESEARCH ON THE INFLUENCE OF IONS ON ROCKET COMBUSTION (Abstract), by J. Nichol. [1960] [1]p. (Bound with its AFOSR-TN-60-405; AD 235949) (AF 49(638)305) Unclassified

Presented at Third AFOSR Contractors' meeting on Ion and Plasma Propulsion, Republic Aviation Corp., Farmingdale, N. Y., Mar. 22-24, 1960.

The results of Langmuir probe measurements in rocket combustion chambers are presented. In all cases where alkali metal additives were used to seed the flame gases, the experimental ion concentrations were less than or equal to the concentrations calculated for the equilibrium ionization. There is substantial indication that the ionization is controlled to a significant extent by unanticipated chemical equilibria, such as alkali metal hydroxide formation, at temperatures in the neighborhood of 3000°K. The data suggest that for seeded flames the calculated equilibrium ionization in the combustion chamber can be used as a confident estimate for the upper bound of the actual ionization. The max degree of ionization attained in these experiments was approx 10^{-2} mol-%, and the corresponding max value of electrical conductivity reduced the magnetic interaction parameter (the product of the magnetic Reynolds number and the magnetic pressure number) to values of less than 10^{-2}.

2762

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

HEAVY PARTICLE PROPULSION RESEARCH, by R. E. Wiech, Jr. July 1-Dec. 31, 1959, 61p. incl. illus. diagrs. tables. (Rept. no. RMD-1155-S2) (AFOSR-TR-60-48) (AF 49(638)657) AD 236838; PB 147519 Unclassified

The precontractual work was primarily concerned with the generation of charged heavy particles from the liquid state. Various particle generator cells were tried, all of which performed the dual operation of charge and spray. The experimental work was limited to the generation of charged heavy particles from the solid state. The general problems of particle charging mechanisms and the effect of charge-to-mass ratio distribution upon powerplant performance were theoretically investigated. Based upon theoretical conclusions, an experimental steady flow unit was constructed. The purpose of this unit is to supply numerical information about several theoretical parameters. This unit has a max accelerating voltage of only 120 kv, with a max power of about 500 w. From present results, this voltage is approx 5% of the accelerating potential required for an operational system. The approx characteristics of the research unit are: mass flow rate = 1 mg/sec, thrust = 50 to 150 dy (voltage sensitive), performance = 100 sec (voltage sensitive), and a propellant of iron powder (300A mean diam). (Contractor's abstract)

2763

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

HEAVY PARTICLE PROPULSION RESEARCH, by D. M. Jamba. Jan. 1-Apr. 30, 1960, 34p. incl. illus. diagrs. tables. (Rept. no. RMD-1155-S3) (AFOSR-TR-60-79) (AF 49(638)657) AD 240971; PB 149903 Unclassified

Work is continuing on the generation, charging, and acceleration of multi-atom particles to determine the characteristics of particle beams as they may apply to advanced electric propulsion systems. Major efforts were concerned with the handling of previously prepared fine powders. Many types of mechanisms were tested to charge, hold, and feed these solid metal particles, with the end purpose of obtaining a continuous beam of charged particles having an average specific charge in the range of 1 to 100 coulombs/kg. Several measurement systems and techniques were investigated to determine their advantages and limitations. No one system was found that could be used for general comparison and evaluation of charged particle beam properties. The results demonstrate that further research must endeavor to understand the charging processes in greater detail since the ability to generate particles of predictable and controlled properties is fundamental to experimental progress. (Contractor's abstract)

2764

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

HEAVY PARTICLE PROPULSION RESEARCH (Abstract), by R. E. Wiech, Jr. [1960] [1]p. (Bound with its AFOSR-TN-60-405; AD 235949) (AF 49(638)657) Unclassified

Presented at Third AFOSR Contractors' meeting on Ion and Plasma Propulsion, Republic Aviation Corp., Farmingdale, N. Y., Mar. 22-24, 1960.

Charged particle propulsion systems differ mainly from ion propulsion systems by the low value of the charge-to-mass ratio of the working fluid and by the fact that the working fluid has a distributed charge-to-mass ratio. The thrust recovery is in general less than for uniformly charged working fluids, which have a theoretical 100% thrust recovery. The thrust recovery of commonly encountered charge-to-mass ratio distributions is over 97% but under adverse distributions can fall to below 75%. If the poor distributions are broken up into approx rectangular segments and each segment accelerated separately through a potential E according to the relationship $E \propto \frac{m}{Q}$ then the overall thrust recovery can be increased from a low value to greater than 94%. The experimental program to date has primarily employed iron particles of 300A diam and greater in the study of heavy particle propulsion. The reason for this is that electrostatic, gravitational, as well as magnetic forces may be applied to the particles. Although theoretical studies show that smaller particles than these have great advantages, they have not been employed to date because of experimental difficulties, e.g., the pyrophoric nature of very small particles. In addition, the theoretical studies can be checked on larger particles. For example, theoretical studies indicate that large iron particles charged by induction should have approx twice the

charge-to-mass ratio when held to the charging stage by a magnetic field of 50 gauss as when they are held by gravity. This has been corroborated experimentally. (See also item no. 2762, Vol. IV) (Contractor's abstract)

2765

Thompson Ramo-Wooldridge, Inc. Ramo-Wooldridge Div., Canoga Park, Calif.

TRANSIENT AND STEADY STATE BEHAVIOR IN CESIUM ION BEAMS, by J. M. Sellen and H. Shelton. [1960] 62p. incl. illus. diagrs. (Rept. no. RW-RL-186) (AFOSR-TN-60-1395) (AF 49(638)886)
AD 250289 Unclassified

Presented at ARS Electrostatic Propulsion Conf., U. S. Naval Postgraduate School, Monterey, Calif., Nov. 3-4, 1960.

Also published in Progr. in Astronaut. and Rocketry, v. 5: 305-356, 1961.

The experiments with broad cesium ion beams are divided into 4 categories: (1) steady state non-oscillatory ion beams; (2) transient behavior in pulsed ion beams; (3) steady state oscillatory ion beams; and (4) steady state, non-oscillatory ions and electron beams. For (1), ion flow variation to the collector was analyzed as the accelerator grid-to-collector distance was varied. As the collector was withdrawn, the ion beam experienced increased difficulty in crossing the grid to collector interspace; at a critical point the bulk of the current was reflected back to the source. Section (2) was concerned with the time interval from the instant the ion beam was accelerated through the grid until the accumulation of trapped electrons was complete. After neutralization of the ion beam, steady oscillatory behavior (3) occurred and continued as long as the beam was left in operation. An injection of electrons, in addition to those already in the beam as secondaries, resulted in the situation (4) where the beam currents of ions and electrons were equal and non-oscillatory.

2766

Thompson Ramo-Wooldridge, Inc. Ramo-Wooldridge Div., Los Angeles, Calif.

ELECTROSTATIC ACCELERATION OF MICROPARTICLES TO HYPERVELOCITIES, by H. Shelton, C. D. Hendricks, Jr., and R. F. Wuerker. [1960] [4]p. incl. diagrs. [AF 49(638)886] Unclassified

Published in Jour. Appl. Phys., v. 31: 1243-1246, July 1960.

By electrostatic methods, μ-diam spheres of iron were accelerated to hypervelocities. Techniques were developed to give single impacts in vacuum of measured incident velocity, mass and position. In comparison to other ballistic methods, the electrostatic system has the following features: (1) The entire experiment conducted in high vacuum provides an excellent simulation of free space environment and freedom from extraneous effects of propellants or shock waves. (2) The point of impact can be localized by electrical measurements, thus greatly facilitating the location of the very small craters. (3) The velocity and mass of each particle can be directly measured just before impact. (4) The attainable particle velocity is limited only by the total accelerating potential available; a possible source of high potential for the electrostatic accelerator might be a Van de Graaff generator.

2767

Tiltman Langley, Ltd., Surrey (Gt. Brit.).

AN ITERATIVE ANALOGUE COMPUTER FOR: STUDY OF THE TURBULENT FLAME PROPERTIES OF ELEMENTARY COMBUSTION CHAMBERS, by A. J. Cooper and I. C. Hutcheon. Nov. 30, 1959, 27p. incl. illus. diagrs. tables, refs. (Technical scientific note no. 3) (AFOSR-TN-60-993) (AF 61(514)1213)
AD 242429; PB 150354 Unclassified

An iterative analogue computer is described as it has been designed and built for solving up to 20 simultaneous equations of the form $\tau_j = \frac{1}{L} \sum_k b_{jk} \psi(\tau_k)$ where L is an adjustable parameter (eigenvalue), b_{jk} is a set of up to 20 x 20 coefficients and ψ is a linear or non-linear relationship. The study of turbulent combustion chamber flame patterns is carried out on the computer so as to determine the b_{jk} a set of influence coefficients which relate the local temperature τ_j at any point j to the rates of heat generation at k points throughout the flame, and ψ a reaction rate function.

2768

Tiltman Langley, Ltd., Surrey (Gt. Brit.).

TRACER STUDIES OF MIXING IN THE WAKE OF FLAME HOLDERS, by D. B. Spalding. Nov. 30, 1959 [94]p. incl. diagrs. tables. (Technical note no. 2) (AFOSR-TN-60-1004) (AF 61(514)1213) AD 242428; PB 150359 Unclassified

The wake regions of 4 axially-symmetrical flameholders were studied by the injection of a tracer (argon) at 1 location and the analysis of the tracer concentration at the 2nd location. Both injection and sampling locations were varied so as to provide comprehensive description of mixing patterns in terms of influence coefficients, surveys being carried out when the gas stream was pure air (cold flow) and when the gas stream was a propane-air mixture burning behind the baffle (hot-flow). The influence coefficients were used to enable predictions to be made of the flame-holding characteristics of the baffles, in terms of their dimensionless chemical loading factor for extinction. It was demonstrated that the values of the influence coefficients, and for the sizes of the recirculation zones, were appreciably larger for the hot-flow than for the cold. Loading

factors predicted from the hot-flow influence coefficients are therefore an order of magnitude greater than those based on the cold-flow coefficients. (Contractor's abstract)

2769

Toronto U. Inst. of Aerophysics (Canada).

MEASUREMENT OF TWO-POINT CORRELATIONS SHEDDING A KARMAN VORTEX STREET, by M. Y. el Baroudi. Jan. 1960 [27]p. incl. illus. diagrs. (UTIA Technical note no. 31) (AFOSR-TN-60-835) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)249 and Canadian Defence Research Board) AD 247495 Unclassified

Results of an experimental investigation of 2-point correlations of velocity near a circular cylinder shedding a Karman vortex street are presented. The measurements were made along a line parallel to the generator of the cylinder which is at 90° from the upstream direction. The cylinder was mounted transversely in an air-stream, and 2 hot-wire probes were used as anemometers. The curves of correlation coefficient versus probe separation approach zero as the separation between the probes is increased to large values. A plot of correlation length versus Reynolds number, based in part on a conservative extrapolation, is also presented and compared with correlation length data from pressure measurements. (Contractor's abstract)

2770

Toronto U. Inst. of Aerophysics (Canada).

A THEORY OF THE SOUND FROM JETS AND OTHER FLOWS IN TERMS OF SIMPLE SOURCES, by H. S. Ribner. July 1960 [52]p. incl. diagrs. refs. (UTIA rept. no. 67) (AFOSR-TN-60-950) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)249 and Canadian Defence Research Board) AD 247443 Unclassified

The elementary generators of flow noise are pictured as source-like pulsations of the moving fluid elements in response to the local inertially-produced pressure fluctuations, $p^{(o)}$. The acoustic source strength is $\sim D^2p^{(o)}/Dt^2$. The sources, although individually nondirectional, jointly yield a directionality for the radiated sound from jets; it arises in part from convection of the sources and in part from refraction by the mean shear flow. Use of the 2-point covariance of source strength with retarded time provides a formalism for treating the convective effects. The formalism is applied to simulated jets to calculate convective spectrum effects in the source fields, Doppler shifts in the far field, and overall directionality of the radiated sound for both static and subsonically moving jets. (Contractor's abstract)

2771

Toronto U. Inst. of Aerophysics (Canada).

ENERGY FLUX FROM AN ACOUSTIC SOURCE CONTAINED IN A MOVING FLUID ELEMENT AND ITS RELATION TO JET NOISE, by H. S. Ribner. [1960] [2]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)249] and Canadian Defence Research Board) Unclassified

Published in Jour. Acoust. Soc. Amer., v. 32: 1159-1160, Sept. 1960.

It is found that a high-frequency source (or multipole) imbedded in a moving patch of fluid emits a constant acoustic power independent of the motion. (The directivity is, however, altered). This holds when the wavelength $\lambda \ll$ radius R' of the entire region of flow. At the other extreme $\lambda \gg 2\pi R'$ it appears that the acoustic power is enhanced by the motion, somewhat (but not exactly) as the emission of a source is enhanced by motion through fluid at rest. A typical wavelength of a radiating eddy in a jet lies between the 2 extremes and a limited convective enhancement of the power is inferred. The amount should be less than that predicted by Lighthill or the much more conservative values suggested by the work of Ribner; it could conceivably lie within experimental error, justifying the nonconvective law, power $\sim U^8$, found by measurement. (Contractor's abstract)

2772

Toronto U. Inst. of Aerophysics (Canada).

MEASUREMENT OF ROTATIONAL TEMPERATURE, VIBRATIONAL TEMPERATURE, AND MOLECULE CONCENTRATION IN NONRADIATING FLOWS OF LOW DENSITY NITROGEN, by E. P. Muntz. Apr. 1961 [98]p. incl. illus. diagrs. tables, refs. (UTIA rept. no. 71) (AFOSR-TN-60-499) (AF 49(638)281) AD 258554 Unclassified

A method was developed for measuring rotational temperature, vibrational temperature, and molecule concentration, in nonradiating flows of low density nitrogen. The method involves the passing of a narrow beam of high energy electrons through the flow. The beam electrons excite a relatively strong emission from the first negative system of the nitrogen molecular ion N_2^+. The rotational and vibrational temperatures, as well as number density, of the ground state nitrogen molecules can be inferred from observations of the beam excited first negative system. Particular emphasis was placed on the measurement of rotational temperature. A theoretical prediction was made of the relative intensities of the rotational lines in the first negative system. The prediction of the relative intensities, as a function of the rotational temperature of the ground state molecules, was checked experimentally and found to apply to within the accuracy of the experiments (±2% for rotational temperature measurements). (Contractor's abstract)

2773

Toronto U. Inst. of Aerophysics (Canada).

MEASUREMENT OF THE DENSITY DISTRIBUTION IN A RAREFIED GAS FLOW USING THE FLUORESCENCE INDUCED BY A THIN ELECTRON BEAM, by E. O. Gadamer. Mar. 1962 [41]p. incl. illus. diagrs. tables, refs. (UTIA rept. no. 83) (AFOSR-TN-60-500) (AF 49(638)281) AD 277170 Unclassified

The concept of utilizing a confined gaseous fluorescence, induced by a thin but energetic electron beam, for the measurement of local rarefied gas densities, notably in a low-density flow field, was applied in the development of an optical electron beam density probe. The instrument consists of a high-voltage electron gun sealed to the test section of a low-density aerodynamics facility. One or more small-diameter exit tubes allow the generated electron beam to enter the flow field. The beam-induced fluorescence which is coincident with the beam and whose intensity depends on the local gas density, is detected by a photomultiplier arrangement. The measured photocurrent is calibrated directly against the gas density. Point measurements are made feasible by controlling the location of the gun with the help of a traversing mechanism, and by selecting the radiation coming from a small section of the electron beam. The following topics are discussed: relevant properties of the fluorescence mechanism, sealing of an electron gun to a low-density aerodynamics facility, design considerations for an electron gun, the calibration, and limitations of the method. Results are presented from an experimental investigation of the radial density distribution of the molecular flux that emerges from a short cylindrical tube. Comparison with a theoretical solution is made. (Contractor's abstract)

2774

Toronto U. Inst. of Aerophysics (Canada).

METHOD OF MEASURING STATIC TEMPERATURE IN A LOW-DENSITY GAS FLOW (Abstract), by E. P. Muntz. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)281] and Canadian Defence Research Board) Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 372, June 15, 1960.

When a collimated beam of electrons of moderate energy (10 to 20 kv) is passed through a low-density jet of nitrogen or air, the emission spectrum obtained is predominantly from the molecular ion N_2^+. At normal temperatures the strongest emission is in the O-O band λ3914. Experiments have been conducted to determine the feasibility of measuring the temperature of the gas from the intensity distribution in the rotational fine structure of the O-O band. In the experiments a 1.65-mm diam electron beam, with an energy of 16,600 v and a beam current of 250μa, was passed through a stream of nitrogen with a static pressure of approximately 150μHg. The temperature of the nitrogen stream was known and could be adjusted from room temperature to 373°K. From the relative intensities of the rotational lines in the O-O band ($^2\Sigma - {}^2\Sigma$ transition) rotational temperatures were obtained. For the experiment the rotational and translational degrees of freedom were in equilibrium, so that a comparison between the spectrographically determined rotational temperatures and the known flow temperatures was possible. For results obtained to date, the spectrographically determined temperatures have been within a maximum deviation of ±2% of the known flow temperatures. This scatter is within the estimated experimental error.

2775

Toronto U. Inst. of Aerophysics (Canada).

SYSTEMATIC AXIAL LOAD FATIGUE TESTS USING UNNOTCHED ALUMINUM ALLOY 2024-T4 EXTRUDED BAR SPECIMENS, by S. R. Swanson. May 1960 [56]p. incl. illus. diagrs. tables. (UTIA Technical note no. 35) (AFOSR-344) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)548, AVRO Aircraft Ltd., and Canadian Defence Research Board) AD 258552 Unclassified

A series of axial-load fatigue tests were performed on Al alloy 2024-T4 extruded bar, using a mean tensile stress of 16 ksi. The basic single-level SN relation was established using 9 specimens at each of 15 alternating stress amplitudes. The statistical behavior of the single-level fatigue endurance at the knee of the SN curve was discovered to be consistent with the rise and decay respectively of 2 endurance distributions, apparently representing the action of 2 different fatigue mechanisms. The log-endurance population during transition became bimodal in nature, with the first distribution a continuation of the log normal distributions at stress amplitudes above this region. An extensive 2-level test program was carried out. By this procedure, areas of severe damage accumulation were delineated, as were areas of so-called healing which occur at certain high stress levels (0.1% proof stress), and at high numbers of cycles at low stress levels. (Contractor's abstract, modified)

2776

Toronto U. Inst. of Aerophysics (Canada).

LONGITUDINAL DYNAMICS OF A LIFTING VEHICLE IN A CIRCULAR ORBIT, by B. Etkin. Feb. 1960 [35]p. incl. diagrs. table, refs. (UTIA rept. no. 65) (AFOSR-TN-60-191) (AF 49(638)761) AD 237848 Unclassified

Presented at Decennial Symposium of the Inst. of Aerophysics, Oct. 15, 1959.

For abstract see item no. 2770, Vol. IV.

2777

Toronto U. Inst. of Aerophysics (Canada).

NON-LINEAR EFFECTS IN THE LONGITUDINAL DYNAMICS OF A LIFTING VEHICLE IN A CIRCULAR ORBIT, by R. S. Rangi. Oct. 1960 [52]p. incl. diagrs. tables. (UTIA Technical note no. 40) (AFOSR-210) (AF 49(638)761) AD 256307 Unclassified

The second order terms were added to the linear equations of motion for a lifting vehicle in a circular orbit with small perturbations. The gravity-gradient effect on pitching moment is also included. The equations were solved on an analogue computer. Transient solutions were obtained. The effect of gravity gradient became more important than the aerodynamic moment at high altitude and governed the pitching mode. The second order effects for the perturbations considered were found to be unimportant. It was concluded that the linear theory is applicable so long as the non-dimensional perturbation quantities are of reasonable order, say 0.2. (Contractor's abstract)

2778

Toronto U. Inst. of Aerophysics (Canada).

LONGITUDINAL DYNAMICS OF A LIFTING VEHICLE IN ORBITAL FLIGHT, by B. Etkin. [1960] [11]p. incl. diagrs. tables, refs. (AFOSR-3598) (AF 49(638)761) AD 613139 Unclassified

Presented at Nat'l. summer meeting of the Inst. Aeronaut. Sci., Aerodynamics Session, Los Angeles, Calif., June 28-July 1, 1960.

Also published in Jour. Aero/Space Sci., v. 28: 779-789, 832, Oct. 1961.

A report is presented of an analytical study of the longitudinal perturbations to the steady orbital flight of a lifting self-propelled vehicle in a circular orbit. The equations are so formulated as to lead to the correct limits at the 2 extremes—satellites in space and aircraft in the lower atmosphere. Additions to the conventional equations of airplane dynamics are found to be necessary to account for the vertical gradients of gravity and atmospheric density and for the curvature of the undisturbed flight path. Calculations were performed with both linear and nonlinear equations for a particular set of aerodynamic and inertial parameters, and altitudes from 100,000 to 700,000 ft. The linear solutions contain 2 oscillatory components which can be identified with the classical phugoid and short-period modes, and a new spiral mode which may be unstable or stable, depending on the thrust law. With increasing altitude, the period of the phugoid approaches asymptotically to the orbital period, and that of the "short"-period mode tends to infinity. In the altitude range of nearly equal periods there is beating of the 2 oscillations, producing dynamic instability in pitch. The solutions of the non-linear equations show that the linear theory is valid for a practical range of the disturbance amplitudes. (Contractor's abstract)

2779

Training Center for Experimental Aerodynamics, Brussels (Belgium).

LOW PRESSURE AERODYNAMIC FACILITIES; Proc. of the Round Table Conf., London (Gt. Brit.) Oct. 25-27, 1960, ed. by J. J. Smoldern. [1960] [145]p. incl. illus. diagrs. tables, refs. (Technical memo. no. 12) (AFOSR-713) (Sponsored jointly by Advisory Group for Aeronautical Research and Development, Air Force Office of Scientific Research and Office of Naval Research) Unclassified

Various aspects of low-pressure aerodynamics are discussed. Topics considered are pumping systems, instrumentation, and low density facilities components.

2780

Training Center for Experimental Aerodynamics, Brussels (Belgium).

LAMINAR SEPARATION IN SUPERSONIC FLOW WITH EMPHASIS ON THREE-DIMENSIONAL PERTURBATIONS AT REATTACHMENT, by J. J. Ginoux. Final rept. Feb. 1960 [41]p. incl. illus. diagrs. tables. (Technical note no. 3) (AFOSR-TN-60-237) (AF 61-(514)993) AD 236856; PB 147503 Unclassified

It is shown that regular and repeatable span-wise flow perturbations exist in the reattachment region of a laminar supersonic boundary layer on a 2-dimensional backward-facing step model. The model span and leading-edge thickness, when below 0.1 mm, had no effect on the wavelength of the flow perturbations. On backward-facing steps, at a Mach number of 2.16, the ratio of wavelength of the flow perturbations to boundary layer thickness was a function of the ratio of step height to boundary layer thickness. Similar perturbations were found at the reattachment region of a laminar boundary layer on forward-facing steps, on compression corners, on rectangular cavities, and in the case of interaction between a shock wave and the boundary layer. They were also detected in unseparated boundary layers. The presence of 3-dimensional perturbations seems to be related to the general question of boundary layer stability. (Contractor's abstract)

2781

Training Center for Experimental Aerodynamics, Brussels (Belgium).

THE EXISTENCE OF THREE-DIMENSIONAL PERTURBATIONS IN THE REATTACHMENT OF A TWO-DIMENSIONAL SUPERSONIC BOUNDARY-LAYER AFTER SEPARATION, by J. J. Ginoux. Feb. 1960 [23]p. incl. illus. diagrs. tables. (Technical memo. no. 3) (AFOSR-TN-60-885) (AF 61(514)993) AD 240501 Unclassified

Presented at AGARD Wind Tunnel and Model Testing Panel, Boundary-Layer Research meeting, London (Gt. Brit.), Apr. 25-29, 1960.

The reattachment region of a laminar boundary layer after separation was investigated at M = 2.16. Two-dimensional compression corners and backward or forward facing step models were used. The case of interaction between a shock wave and a laminar boundary layer was also considered. Surface flow was observed by a sublimation technique and detailed span-wise surveys were made in the reattachment region of the flow with total-head probes. Strong, regular and repeatable span-wise perturbations were observed in the boundary layer; these could not be explained by irregularities either in the air flow upstream of the models or in the models themselves. It was found in all cases that street-like flow perturbations existed up to the point where transition occurred. A systematic investigation was made on backward facing steps in order to find out the effects of step height and boundary layer thickness on the wavelength of the flow perturbations. (Contractor's abstract)

2782

Training Center for Experimental Aerodynamics, Brussels (Belgium).

SEPARATED SUPERSONIC FLOWS, by J. J. Ginoux. [1960] [13]p. incl. illus. diagrs. table. (AF 61(514)-893) Unclassified

Published in Proc. Heat Transfer and Fluid Mech. Inst., Stanford U., Calif. (June 15-17, 1960), Stanford U. Press, 1960, p. 179-191.

The reattachment of a laminar boundary-layer after separation has been investigated at a Mach number of 2.16. Surface flow was observed by a sublimation technique and detailed span-wise surveys were made in the reattachment region of the flow with total head probes. Strong, regular, and repeatable span-wise perturbations were observed in the boundary layer. Similar perturbations were also found at the region of reattachment of a laminar boundary-layer on forward facing steps, on compression corners and in the case of interaction between a shock wave and the boundary layer. In all cases street-like flow perturbations existed up to the point where transition occurred. A systematic investigation was made on backward facing steps to determine the effects of step height and boundary layer thickness on the wave length of the flow perturbations. (Contractor's abstract)

2783

Trieste U. Inst. of Physics (Italy).

ON THE TOTAL SPECIFIC IONIZATION, by P. Budini, L. Taffara and C. Viola. July 12, 1960 [25]p. incl. diagrs. tables, refs. (Scientific note no. 1) (AFOSR-TN-60-1088) (AF 61(052)211) AD 244467 Unclassified

A method is given for calculating the absolute value of primary, secondary and total specific ionization generated by an ionizing particle traversing a given medium. Density effect is taken into account. Numerical results are given for H and He and compared with existing experimental data. It is shown that primary ionization presents higher relativistic increase (lower density effect), than total ionization when the dilution of secondary ionization is felt. Further primary ionization is independent on maximum transferable energy in close collisions which on the contrary influences sensibly ionization of higher generations. Simplified formulae are given where the influence of the physical characteristics of the medium on the phenomenon appears evident and which are apt to be compared with the experimental results. (Contractor's abstract)

2784

Trieste U. Inst. of Physics (Italy).

ON A POSSIBLE ENHANCEMENT OF RELATIVISTIC INCREASE IN IONIZATION, by P. Budini, L. Taffara and C. Viola. Dec. 15, 1960 [12]p. incl. diagrs. (Scientific note no. 2) (AFOSR 508) (AF 61(052)211) AD 255005 Unclassified

Also published in Nuovo Cimento, Series X, v. 20: 265-273, Apr. 16, 1961.

Theoretical analysis indicates that reabsorption of Cerenkov radiation in special mixtures of elements with different ionization potentials should give an appreciable enhancement of relativistic increase of primary ionization. Mixtures of H + He and He + alcohol are discussed. It would be useful to prove experimentally the existence of such an effect for its potential application in high energy physics, i.e., particle detection. (Contractor's abstract, modified)

2785

Trieste U. Mathematical Inst. (Italy).

INVARIANT MEASURES CONCERNED WITH NAVIER-STOKES EQUATIONS IN TWO VARIABLES, by G. Prodi. Sept. 1960, 21p. incl. refs. (Technical note no. 1) (AFOSR-187) (AF 61(052)414) AD 254382 Unclassified

Analytical results concerning Navier-Stokes equations and the existence of invariant measures are studied. Particular attention is given to the existence of invariant measures in the case of a constant solution.

2786

Tufts U. Inst. for Applied Experimental Psychology, Medford, Mass.

A SURVEY OF OPERATIONS AND SYSTEMS RESEARCH LITERATURE, by M. W. Raben. Jan. 1, 1960, 33p. incl. diagr. refs. (AFOSR-TR-80-92) (Sponsored jointly by Air Force Office of Scientific Research and Office of Naval Research under Nonr-49413) AD 233505 Unclassified

The purpose of the present work is to bring together in one source brief treatments of the unclassified publications on operations and systems research regarded as

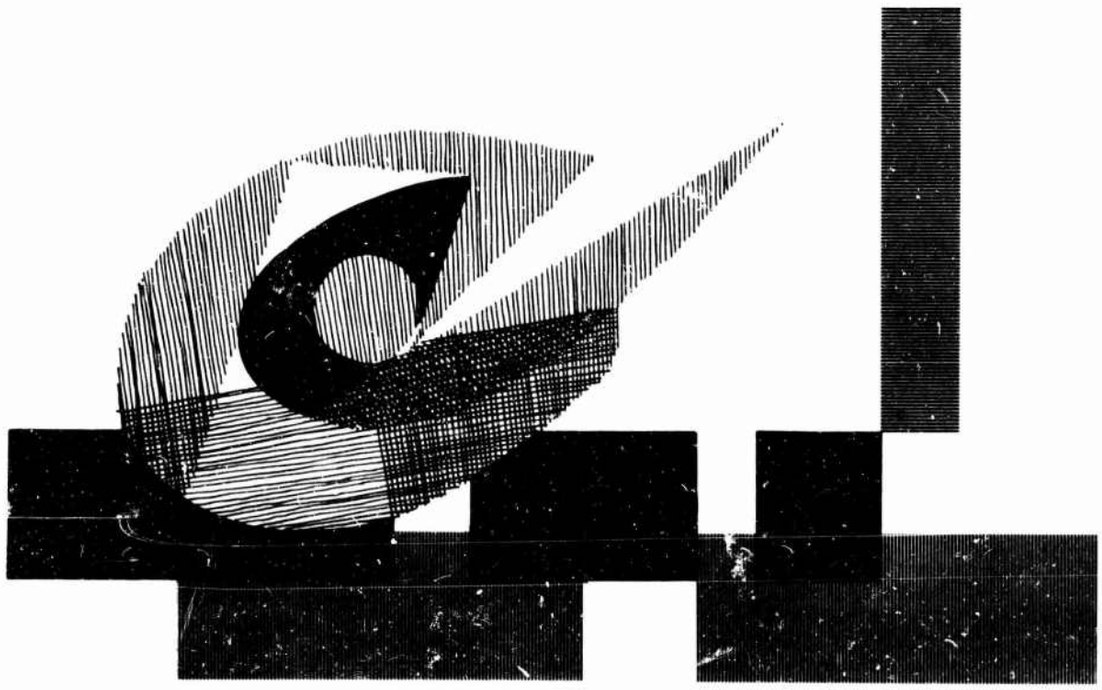
important by those working in these areas. The organization of the material is by parts, chapters, and headings within chapters. A detailed table of contents appears at the front of the report and a subject index at the end. Included are 2 lists, containing a total of approximately 1,020 references. Part I of the report explores the problem of definition and certain background materials relating to the capabilities of men and machines. Part II is devoted to reviewing the references which are primarily methodological in nature. Methods of experimental and engineering psychology, operations and system research methods in general, communication and information theory, game theory and linear programming, computers and simulation techniques, as well as queueing theory and work measurement techniques are discussed in some detail. Part III contains presentations of the more problem-oriented references, i. e. studies of individuals and of groups as system components, and approaches to communication and transportation problems. A chapter on air traffic control, and one on production, maintenance, and supply problems are included.

2787

Turin U. (Italy).

SOME TOPICS IN POTENTIAL SCATTERING THEORY AND ITS HIGH ENERGY LIMIT, by M. Verde. Final rept. Mar. 31, 1960 [23]p. incl. refs. (AFOSR-TN-60-680) (AF 61(052)230) AD 244466
Unclassified

A discussion of potential scattering is considered with the purpose of investigating the functional dependence of some analytic properties of the scattering amplitude from the corresponding ones of the potential. The case of fixed and real angular momentum is investigated. An integral equation, which is a kind of dispersion relation equation for the wave-function, forms the basis for deriving asymptotic expansions of phase-shifts valid for large values of the energy. The coefficients of these expansions are expressed as moments over the distribution of the singularities of the S or R matrices. The case of fixed and real energy is investigated. A careful study was made of the nature and distribution of singularities of the scattering amplitude in the complex plane of angular momentum. The use of the so called Watson-transformation leads to an asymptotic estimate of the total scattering amplitude for large values of cos Θ which is an important result needed for the derivation of the so called Mandelstarn representation in potential scattering. (Contractor's abstract)



Universita di Roma (Italy) see
Rome U. (Italy).

Université Libre de Bruxelles (Belgium) see
Free U. of Brussels (Belgium).

2788

Uppsala U. Gustaf Werner Inst. for Nuclear Chemistry, (Sweden).

RESEARCH ON "LOCALIZED RADIO-LESIONS". PART III. BLOOD VESSEL CHANGES FOLLOWING LOCAL IRRADIATION OF THE BRAIN WITH HIGH ENERGY PROTONS, by B. Larsson. Dec. 1, 1959 [16]p. incl. illus. diagr. table, refs. (Technical rept. no. 1, Appendix 5) (AFOSR-TN-60-252) (AF 61(514)1247) AD 233372; PB 146305 Unclassified

The cerebral cortex and thalamus in the brain of the rat were locally irradiated with a narrow beam of high-energy protons. The developing radiolesion was studied particularly with regard to changes in capillary function. Semiquantitative comparison between effects at different times after irradiation with different doses in the region 10-40 krad was attempted. Three types of changes were noted: impairment of capillary circulation, increase of permeability of trypan blue through the blood-brain barrier system, and necrosis. The results show that the detection of changes in the blood-brain barrier system with suitable dyes or radioactive compounds may be applied as a means of early diagnosis of the radiolesion. (Contractor's abstract)

2789

[Uppsala U. Gustaf Werner Inst. for Nuclear Chemistry] (Sweden).

RESEARCH ON "LOCALIZED RADIO-LESIONS". PART IV. LABORATORY OBSERVATIONS ON THE REPRODUCTIVE BEHAVIOR OF THE PIGEON (COLUMBA LIVIA) DURING THE PRE-INCUBATORY PHASE OF THE BREEDING CYCLE, by E. Fabricius and A.-M. Jansson. Mar. 1, 1959 [31]p. incl. diagrs. tables, refs. (Technical rept. no. 1, Appendix 2) (AFOSR-TN-60-253) (AF 61(514)1247) AD 233373; PB 146313 Unclassified

The reproductive behavior of the pigeon was studied in pairs which were allowed free access to each other only once a day, during a 34 min observation period. The different actions typical of the reproductive behavior are described. The most important of these are bowing, attacking intention, attacking, driving, nest demonstration, moulding, nibbling, pushing, begging, billing, displacement preening, pecking, squatting, strutting, mounting, copulation, collecting of nest material, nest-building and nest defense. The courtship actions do not form rigid chains. Each activity can be followed or preceded by several others, but often the association with some particular activities predominates. The actions that compose the courtship pattern seem to form 3 rather distinct groups. The first of these is the primarily aggressive behavior, represented by bowing, attack intention and attacking. The driving seems to be more closely associated with this group than with any other. The second group is the sexual behavior proper. The third group is formed by nest demonstration, pushing, collecting of nest material and nest-building. The function and origin of some of the courtship actions is discussed. This daily contact between male and female during a period of 12 to 15 days was sufficient to produce broodiness and egg-laying. (Contractor's abstract, modified)

2790

Uppsala U. Gustaf Werner Inst. for Nuclear Chemistry (Sweden).

RESEARCH ON "LOCALIZED RADIO-LESIONS". PART V. OBSERVATIONS OF PIGEONS DECEREBRATED WITH HIGH ENERGY PROTONS, by E. Fabricius and B. Larsson. Apr. 1, 1959 [24]p. incl. illus. table, refs. (Technical rept. no. 1, Appendix 3) (AFOSR-TN-60-254) (AF 61(514)1247) AD 233374; PB 146312 Unclassified

Four pigeons were decerebrated by radiolesions produced by 185 mev protons from a synchrocyclotron. The cerebral peduncles were cut off at the level of the anterior commissure and the bending point of the tractus septo-mesencephalicus. Escape response and spontaneous feeding and drinking disappeared in all the birds, as well as all social behavior, including calling. The ability of walking, standing in a normal position, and maintaining the equilibrium remained. All birds lost the ability of passing food from the crop into the stomach. Other specific conditions are noted. The method of producing lesions by a proton beam proved promising for functional studies on the bird brain. The lesions were distinctly restricted. No damage to surrounding structures and no condition of shock were observed. (Contractor's abstract, modified)

2791

Uppsala U. Gustaf Werner Inst. for Nuclear Chemistry (Sweden).

BLOOD VESSEL CHANGES FOLLOWING LOCAL IRRADIATION OF THE BRAIN WITH HIGH-ENERGY PROTONS, by B. Larsson. [1960] [11]p. incl. illus. diagr. tables, refs. (AFOSR-TN-60-340) (Sponsored jointly by Air Force Office of Scientific Research under AF 61-(514)1247 and Swedish Technical Research Council) AD 242434 Unclassified

Also published in Acta Soc. Med. Upsaliensis, v. 65: 61-71, 1960.

The cerebral cortex and thalamus in the brain of the rat were locally irradiated with a narrow beam of high-energy protons. The developing radiolesion was studied, special attention being paid to disturbances of capillary function. A semi-quantitative comparison between effects at different times after irradiation with different doses in the region 10-40-krad was attempted.

Three types of changes were graded: impairment of capillary circulation, increase of permeability of trypan blue through the blood-brain barrier system, and necrosis. Depending on the radiation dose, there were periods of 1-14 days after irradiation, during which no changes were found. The first effects observed were impaired capillary circulation damage to the blood-brain barrier system for trypan blue. The latter type of changes was always accompanied or succeeded by visible degeneration of nerve cells leading to necrosis. Circulatory disturbances thus seem to precede the trypan blue staining of irradiated brain tissue. As a matter of further discussion a hypothetical mechanism in consistency with observation and modern concepts of the constitution of the blood-brain barrier system is outlined. The mechanisms involved in the rapid development of lesions described here might be different from those involved in the production of late delayed radionecrosis. The results show that the detection or changes in the blood-brain barrier system with suitable dyes of radioactive compounds may be used as a means of early diagnosis of the radiolesion. (Contractor's abstract)

2792

Uppsala U. Gustaf Werner Inst. for Nuclear Chemistry (Sweden).

RESEARCH ON "LOCALIZED RADIO-LESIONS". SUMMARY. Jan. 7, 1960, 1p. (Technical rept. no. 1 Summary) (AF 61(514)1247) Unclassified

The work has been concerned with the use of the 185 mev proton beam for the production of localized lesions in the central nervous system and with the application of this technique in anatomical-functional experiments. Five papers are listed in which the research is described.

2793

Uppsala U. Gustaf Werner Inst. for Nuclear Chemistry (Sweden).

RESEARCH ON "LOCALIZED RADIO-LESIONS". PART VI. RESTRICTED RADIO-LESIONS IN THE DEPTH OF THE BRAIN PRODUCED BY A BEAM OF HIGH ENERGY PROTONS, by L. Leksell, B. Larsson and others. June 1, 1960 [20]p. incl. illus. diagrs. table. (Technical note no. 1) (AFOSR-TN-60-1406) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)183, Knut and Alice Wallenberg Foundation, Swedish Medical Research Council, and Swedish Technical Research Council) AD 247021 Unclassified

Also published in Acta Radiol., v. 54: 251-264, Oct. 1960.

Restricted lesions were produced in the depth of the goat's brain by means of cross-fire irradiation with a narrow beam of high energy protons. The radiosurgical technique and the histopathology of the lesions are described. It was possible to produce well circumscribed cerebral lesions of a type well suited for physiological experimentation without damaging surrounding nervous tissue. The method may also be applied to neurosurgery in man. (Contractor's abstract)

2794

Uppsala U. Inst. of Chemistry (Sweden).

THE STRUCTURES OF Co_2P, Ru_2P AND RELATED PHASES, by S. Rundqvist. May 4, 1960 [37]p. incl. diagrs. tables, refs. (Technical note no. 12) (AFOSR-TN-60-338) (AF 61(052)40) AD 240307; PB 149581 Unclassified

Also published in Acta Chem. Scand., v. 14: 1961-1979, 1960.

The crystal structures of Co_2P and Ru_2P were refined by using single crystal techniques. Both phosphides crystallize in the C 23 structure type. Co_2P has an extended homogeneity range at higher temperatures; the P-rich limit at 1000°C corresponds to the formula $Co_{1.94}P$. There are evidences that the widening of the homogeneity range is connected with random vacancies on metal atom sites. The final structural data were: a = 5.646A, b = 3.513A, c = 6.608A, and U = 131.1 cu A for the Co_2P crystal; and a = 5.638A, b = 3.507A, c = 6.603A and U = 130.6 Cu A for the $Co_{1.94}P$ crystal. The Co_2P crystal had an R value of 0.088 for the 104 observed reflections. The standard deviations of the Co-Co distances were smaller than 0.004A; those of the Co-P distance were smaller than 0.005A. In the Ru_2P crystal, the unit cell dimensions were: a = 5.902A, b = 3.859A, c = 6.896A. The standard deviations for the Ru-Ru distances were smaller than 0.004A; those for the Ru-P distances were smaller than 0.006A.

2795

Uppsala U. Inst. of Chemistry (Sweden).

BORIDES AND SILICIDES OF THE TRANSITION METALS, by B. Aronsson. July 1, 1960 [110]p. incl. diagrs. tables, refs. (Technical note no. 13) (AFOSR-TN-60-683) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)40 and Swedish State Council of Technical Research) AD 244438 Unclassified

Also published in Arkiv Kemi, v. 16: 379-423, 1961.

The purpose of this paper is to review recent studies on the borides and silicides of the transition elements with particular emphasis on the crystal chemistry of these phases. The crystallographic constants of borides, silicides, and silico-borides are critically reviewed in Chapter 1. In Chapter 2 some physical and chemical data of the borides and silicides are presented and compared with those of the carbides and nitrides. In particular, the connection between trends in the thermodynamic properties of these phases and changes of the equilibria in Me-Si-B, Me-B-X' and Me-Si-X' systems

(Me = transition metal, X' = C, N) on systematic substitution of Me and X' is discussed. The crystal structures of borides and silicides, arranged after increasing ideal content of non-metal(s), are treated in Chapter 3, which is the main part of this paper. In Chapter 4, the relation of borides and silicides to the typical interstitial phases, carbides and nitrides, as well as theoretical speculations on the 'bonding' in these phases are briefly commented on. (Contractor's abstract)

2796

Uppsala U. Inst. of Chemistry (Sweden).

STRUCTURAL FEATURES OF NEW PHASES WITH THE CEMENTITE AND RELATED STRUCTURES, by B. Aronsson and S. Rundqvist. July 1, 1960 [19]p. incl. diagrs. tables, refs. (Technical note no. 14) (AFOSR-TN-60-684) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)40 and Swedish State Council of Technical Research) AD 244439 Unclassified

This paper deals with some metal-rich intermediate phases which were found to crystallize in three closely related structures, i.e. the Fe_3C ($\underline{D}O_{11}$)-, Re_3B-, and Th_7Fe_3 ($\underline{D}10_2$)- types. The crystal structures of the various phases are described and discussed, and similarities and trends — particularly of the environment of the non-metal atoms — is pointed out. A conspicuous similarity is noted between the carbides and borides of the seventh and eighth group metals. Thus several of these phases, e.g. Mn_3C, Fe_3C, Co_3B, Ni_3B and Pd_3B are isomorphous.

2797

Uppsala U. Inst. of Chemistry (Sweden).

X-RAY INVESTIGATIONS ON Me-Si-B SYSTEMS (Me - Mn, Fe, Co). II. SOME FEATURES OF THE Fe-Si-B AND Mn-Si-B SYSTEMS, by B. Aronsson and I. Engström. July 20, 1960 [21]p. incl. diagrs. tables. (Technical note no. 15) (AFOSR-TN-60-685) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)40 and Swedish State Council of Technical Research) AD 244440 Unclassified

Also published in Acta Chem. Scand., v. 14: 1403-1413, 1960.

The main features of the Fe-Si-B system at temperatures around 1000°C have been determined using x-ray diffraction methods. Four ternary phases exist in the metal-rich part of this system. $Fe_{4.86}Si_2B$ is isomorphous with $Co_{4.7}Si_2B$ but has a more metal-rich composition. Fe_5SiB_2 has the Cr_5B_3($\underline{D}8_1$)-structure, while the structure of a phase with the approximate composition $Fe_2Si_{0.4}B_{0.6}$ has not been solved. There is also a ternary Fe-Si-B phase that crystallizes in the cementite-structure, but the equilibria in which this phase is involved have not been clarified. In the Mn-Si-B system, which seems to be quite complicated, particularly in the metal-rich part, a phase Mn_5SiB_2 (isomorphous with Fe_5SiB_2) has been identified. (Contractor's abstract)

2798

Uppsala U. Inst. of Chemistry (Sweden).

A NOTE ON THE COMPOSITIONS AND CRYSTAL STRUCTURES OF MnB_2, Mn_3Si, Mn_5Si_3 AND $FeSi_2$, by B. Aronsson. July 20, 1960 [13]p. incl. tables, refs. (Technical note no. 16) (AFOSR-TN-60-686) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)40 and Swedish State Council of Technical Research) AD 244441 Unclassified

Also published in Acta Chem. Scand., v. 14: 1414-1418, 1960.

The existence of a manganese diboride, MnB_2, with the AlB_2-structure has been confirmed. Faint superstructure lines on the powder photographs of alloys containing Mn_3Si indicate that in this phase, as in Fe_3Si, some ordering of the silicon and metal atoms takes place at temperatures below 1000°C. The reported crystal structures of Mn_5Si_3 and $FeSi_2$ have been confirmed and refined with single crystal data. (Contractor's abstract)

2799

Uppsala U. Inst. of Chemistry (Sweden)

THE CRYSTAL STRUCTURE OF $Ru_{11}B_8$, by J. Aselius. Aug. 3, 1960 [14]p. incl. diagrs. tables, refs. (Technical note no. 17) (AFOSR-TN-60-797) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)40 and Swedish State Council of Technical Research) AD 244442 Unclassified

Also published in Acta Chem. Scand., v. 14: 2169-2176, 1960.

The crystal structure of $Ru_{11}B_8$ was determined by single crystal methods. The orthorhombic unit cell has the following dimensions: a = 11.60$_9$ A, b = 11.34$_2$A and c = 2.83$_6$A. There are two formula units in the elementary cell and the space-group is Pbam - (D^9_{2h}) No. 55. The 22 ruthenium atoms are situated in one 2-fold position and five 4-fold positions with 2 ruthenium atoms in 2(a), 12 ruthenium atoms in three 4-fold positions 4(g): $x_{II} = 0.2844$, $y_{II} = 0.3913$, $x_{III} = 0.0429$, $y_{III} = 0.3952$, $x_{IV} = 0.1686$, $y_{IV} = 0.1740$ and 8 ruthenium atoms in two 4-fold positions 4(h): $x_V = 0.4636$, $y_V = 0.2962$, $x_{VI} = 0.3404$ and $y_{VI} = 0.0616$. The 16 boron atoms are also situated with 4 boron atoms in

4-fold positions 4(g): $x_{II} = 0.34_{79}$, $y_{II} = 0.21_{56}$ and 12 boron atoms in 4-fold positions 4(h): $x_I = 0.13_{98}$, $y_I = 0.01_{81}$, $x_{III} = 0.15_{33}$, $y_{III} = 0.32_{65}$, $x_{IV} = 0.27_{99}$ and $y_{IV} = 0.25_{35}$. (Contractor's abstract)

2800

Uppsala U. Inst. of Chemistry (Sweden).

THE CRYSTAL STRUCTURE OF Re_2P, by S. Rundqvist. Oct. 15, 1960, 13p. incl. diagr. tables, refs. (Technical note no. 19) (AFOSR-TN-60-1079) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)40 and Swedish State Council of Technical Research) AD 252921 Unclassified

Also published in Acta Chem. Scand., v. 15: 342-348, 1961.

The crystal structure of Re_2P was determined by x-ray powder methods. The structure belongs to the C23 type. The dimensions of the orthorhombic unit cell are: a = 5.540A, b = 2.939A, and c = 10.040A. The space group is Pnma with $4Re_I$ in 4(c): $x = 0.829_6$; $z = 0.065_5$; $4Re_{II}$ in 4(c): $x = 0.852_0$; $z = 0.785_0$; and 4P in 4(c): x = 0.395; z = 0.110. The Re_2P structure is compared with that of Ru_2P and notable differences are indicated. The present investigation was undertaken in view of the possible structural relationships between Re_2P and the phosphides of the platinum metals. (Contractor's abstract)

2801

Uppsala U. Inst. of Chemistry (Sweden).

THE CRYSTAL STRUCTURE OF Ni_3S_2 WITH SOME NOTES ON Ni_5Si_2, by G. Pilström. Oct. 15, 1960 [17]p. incl. diagrs. tables. (Technical note no. 18) (AFOSR-TN-60-1080) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)40 and Swedish State Council of Technical Research) AD 252922 Unclassified

Also published in Acta Chem. Scand., v. 15: 893-902, 1961.

The crystal structure of Ni_3Si_2 was determined from single crystal data. The unit cell is orthorhombic and contains 16 formula units. The unit cell dimensions are: a = 12.229A, b = 10.805A, and c = 6.924A. The nickel atoms are situated in 4 eight-fold and 4 four-fold positions and the silicon atoms are situated in 3 eight-fold and 2 four-fold positions. The single crystal data were also used to determine the symmetry and unit cell dimensions of Ni_5Si_2 for which a trigonal unit cell was found. (Contractor's abstract)

2802

Uppsala U. Inst. of Chemistry (Sweden).

THE CRYSTAL STRUCTURE OF Pd_5B_2, (Mn_5C_2) AND Pd_3B, by E. Stenberg. Nov. 1, 1960 [17]p. incl. diagrs. tables, refs. (Technical note no. 20) (AFOSR-TN-60-1120) (AF 61(052)40) AD 252923 Unclassified

Also published in Acta Chem. Scand., v. 15: 861-870 1961.

The crystal structures of Pd_5B_2 and Pd_3B were determined by single crystal methods. Pd_5B_2 has a monoclinic unit cell with the following dimensions: a = 12.786, b = 4.955, c = 5.472A; $\beta = 97°2'$. Pd_3B has the cementite Fe_3C structure. The space-group is Pnma with a = 5.463, b = 7.567, c = 4.852A.

2803

Uppsala U. Inst. of Chemistry (Sweden).

PHOSPHIDES OF THE PLATINUM METALS, by S. Rundqvist. [1960] [2]p. incl. table. (AFOSR-J38) (AF 61(052)40) AD 297173 Unclassified

Also published in Nature, v. 185: 31-32, Jan. 2, 1960.

A preliminary report is presented of x-ray powder and single crystal investigations of phosphides of the platinum metals in order to establish the compositions of the phases and to determine crystal structures. Crystallographic data of the phases Ru_2P, RuP, RuP_2, OsP_2, RhP_3, and IrP_3 are given in table form. It is seen that Co_2P[4] is isostructural with Ru_2P; FeP[5] and CoP[5] are isostructural with RuP; FeP_2[6] is isostructural with RuP_2 and OsP_2; CoP_3[7] and NiP_3[7] are isostructural with RhP_3, PdP_3 and IrP_3, and IrP_2 is probably isostructural with RhP_2. Details of the single crystal investigations will be published later.

2804

Uppsala U. Inst. of Chemistry (Sweden).

OXIDE CHLORIDES AND ORGANOMETALLOID OXIDES AS DONOR MOLECULES, by I. Lindqvist. Mar. 1, 1960 [12]p. (Technical note no. 10) (AFOSR-TN-60-125) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)43 and Swedish Natural Science Research Council) AD 234581; PB 146744 Unclassified

Also published in Acta Chem. Scand., v. 14: 1112-1117, 1960.

A model of an idealized structure has been suggested, which can be used for the discussion of adducts of oxide chlorides and organometalloid oxides. No safe distinction between single and double bond structures can be

made with the experimental data available at present. The results show, however, the importance of inductive effects in donor-acceptor reactions, and some predictions can be made about adducts other than those studied. (Contractor's abstract)

2805

Uppsala U. Inst. of Chemistry (Sweden).

INDUCTIVE EFFECTS ON CHEMICAL BONDS, by I. Lindqvist. Mar. 1, 1960, 31p. incl. tables, refs. (Technical note no. 9) (AFOSR-TN-60-126) (AF 61-(052)43) AD 234582; PB 146743 Unclassified

Inductive effects on a given chemical bond, caused by substitution or addition reactions, are discussed using an approach which divides the bond energy into a heteropolar and a homopolar part. It is possible to give a unified treatment of experimentaiiy established effects of the order of 0.01A. The nature of the donor-acceptor interaction is discussed with consideration of the inductive effects on all the bonds in the donor and acceptor molecules. The consequences in haiogen bridged compounds and in compiex ions are also treated briefly. (Contractor's abstract)

2806

Uppsala U. Inst. of Chemistry (Sweden).

HETEROPOLAR AND HOMOPOLAR BOND ENERGY, by I. Lindqvist. Mar. 1, 1960, 9p. (Technical note no. 8) (AFOSR-TN-60-127) (AF 61(052)43) AD 234583; PB 146742 Unclassified

A concept, heteropolarity, has been defined which permits the division of the bond energy of a localized electron pair bond into a heteropolar and a homopolar part. The variations of these two energy parts with respect to shifts of the heteropolarities of the bonds in binary molecules are discussed. It is suggested that the description of the bond energy proposed is well suited for discussions of inductive effects. (Contractor's abstract)

2807

Uppsala U. Inst. of Chemistry (Sweden).

THE TERNARY COMPOUND $SbCl_5 \cdot TiCl_4 \cdot 3POCl_3$, by G. Adolfsson, R. Bryntse, and I. Lindqvist. Apr. 1, 1960, 3p. (Technical note no. 11) (AFOSR-TN-60-192) (AF 61(052)43) AD 240308; PB 149579 Unclassified

Aiso published in Acta Chem. Scand., v. 14: 949, 1960.

A compound formed in the system $SbCl_5$-$TiCl_4$-$POCl_3$ is studied for the determination of its physical properties. The tentative formula established largely on the evidence of the high melting point (where sublimation occurs) at about +200° is a ternary compound $[TiCl_3(OPCi_3)_3](SbCi_6)$. Ti was determined spectrophotometrically by the peroxide method and P was determined by precipitation as $MgNH_4PO_4 \cdot 6H_2O$ in the presence of EDTA and hydrogen peroxide, and titration by EDTA of the Mg content in the washed precipitate.

2808

Uppsala U. Inst. of Chemistry (Sweden).

THE CRYSTAL STRUCTURE OF $SbCi_5 \cdot PO(CH_3)_3$, by C.-I. Brändén and I. Lindqvist. Sept. 15, 1960 [15]p. incl. diagr. tables, refs. (Technical note no. 12) (AFOSR-TN-60-930) (AF 61(052)43) AD 247020 Unclassified

Also published in Acta Chem. Scand., v. 15: 167-174, 1961.

The crystal structure of $SbCi_5 \cdot PO(CH_3)_3$ is determined and refined from 3-dimensional x-ray data. The compound is isomorphous with $SbCl_5 \cdot POCl_3$. The Sb-O and P-O bond lengths are 1.99 ± 0.02A and 1.61 ± 0.02A respectively. The Sb-O-P bond angle is 139.0° ± 2.4°. Comparisons are made with the structures of $PO(CH_3)_3$ and $SbCi_5 \cdot POCl_3$. The predictions of the bond length variations in these compounds based on the theory for inductive effects on polar bonds is confirmed. The nature of the P-O bond is briefly discussed. (Contractor's abstract)

2809

Uppsala U. Inst. of Chemistry (Sweden).

A FLASH PHOTOLYSIS STUDY OF FLUORESCEIN, by L. Lindqvist. [1960] [60]p. incl. diagrs. refs. (AFOSR-1340) (Sponsored jointly by Air Force Office of Scientific Research under [AF 61(052)43], Rockefeller Foundation, Swedish Natural Science Research Council, and Swedish Technical Research Council) Unclassified

Also published in Arkiv Kemi, v. 13: 79-138, 1960.

Information is provided concerning the reaction mechanisms involved in photosensitized reactions, particularly in relation to photoreduction and photo-oxidation processes. A detailed knowledge of the forms in which fluorescein appears in water solution was required for the study. Therefore the electrolytic dissociation and dimerization of this compound are reported. The experimental results of the kinetic investigation are presented.

2810

Uppsala U. Inst. of Chemistry (Sweden).

A NOTE ON THE CRYSTAL STRUCTURE OF SODIUM DIMOLYBDATE, by I. Lindqvist. [1960] [1]p. [AF 61-(052)43] Unclassified

Pubiished in Acta Chem. Scand., v. 14: 960, 1960.

A relatively low R value of 0.17 for sodium dimolybdate seems to indicate mixed tetrahedral and octahedral coordination around the molybdenum atoms. However, this value by no means proves that the atomic positions are well determined since the contributions from the Mo atoms are too dominating.

2811

Uppsala U. Inst. of Physics (Sweden).

ANTIPROTON ANNIHILATIONS IN COMPLEX NUCLEI, by A. G. Ekspong, A. Frisk and others. [1960] [82]p. incl. diagrs. tables, refs. (Technical note no. 1) (AFOSR-TN-60-937) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)13, phase G and Swedish Atomic Research Council) AD 242433; PB 150351 Unclassified

Also published in Nuclear Phys., v. 22: 353-409, Feb. 1961.

An investigation of 356 antiproton annihilations in nuclear emulsion is reported. The annihilation process in flight is carefully analysed. The experimental pion multiplicity and energy distributions are compared with the predictions of different theories. The ratio of stars with an odd/even number of charged pions is 0.73 ± 0.09 (at rest), which indicates that the probability for antiproton annihilation on neutrons is less than one would expect theoretically. The world data on antiproton annihilations are collected and discussed.

2812

[Uppsala U. Inst. of Physics (Sweden)].

TRANSITIONS FOLLOWING THE DECAY OF Se^{75}, by M. de Crões and G. Bäckström. [1959] [13]p. incl. diagrs. tables, refs. (AFOSR-514) [AF 61(052)13] AD 254463 Unclassified

Also published in Arkiv Fysik, v. 16: 567-579, 1960.

The conversion electron spectrum and the gamma ray spectrum have been re-investigated by means of a double focusing spectrometer. Conversion coefficients have been determined relative to the 279 kev transition in Tl^{203} mainly in order to investigate an EO admixture which according to previous works seemed to exist in the 264 kev transition. The multipolarity was however found to be pure M1, with a max EO admixture of 6×10^{-3}. The conversion coefficients generally support previous spin assignments. Transition energies also support all features of a published decay scheme. Two additional transitions have been found which are not accommodated by the known levels. An electron-gamma coincidence experiment was made in an attempt to locate these transitions. (Contractor's abstract)

2813

Uppsala U. Inst. of Physics (Sweden).

ANGULAR CORRELATION MEASUREMENTS ON LEVELS IN Se^{76} AND Fe^{56}, by Z. Grabowski, S. Gustafsson, and I. Marklund. [1960] [9]p. incl. diagrs. table, refs. (AFOSR-522) [AF 61(052)13] AD 254464 Unclassified

Also published in Arkiv Fysik, v. 17: 411-419, 1960.

The angular distributions of cascading gamma rays in Se^{76} and Fe^{56} have been investigated with an automatic directional correlation apparatus. The measured cascades in Se^{76} are (kev): 560-660, 560-1220, 560-2100, 1220-1220, 1220-1440, giving the following spins of energy levels in Se^{76}, kev $(1,\pi)$: 560(2+), 1216 (2+), 1788 (2+), 2434 (3), 2556 (3-). The first 3 levels may be of 1, 2 and 3 phonon vibrational character respectively, and the 2656 kev level is of probable octupole vibrational type. The cascades 0.35-3.26, 1.24-2.02 and 1.24-1.76 mev in Fe^{56} give a 3+ spin to the 4.10 mev level and a (5+) spin level at 3.84 mev. The spin assignment of the 4.10 mev level is unique 3+, but it is in discrepancy with the interpretations of earlier correlation measurements. (Contractor's abstract)

2814

Uppsala U. Inst. of Physics (Sweden).

DETERMINATION OF A 7×10^{-11} SEC HALFLIFE FOR THE FIRST EXCITED STATE IN THALLIUM 201, by J. L. Lindskog, E. Bashandy, and T. R. Gerholm. [1960] [13]p. incl. diagrs. tables, refs. (AFOSR-523) (AF 61(052)13) AD 254465 Unclassified

Also published in Nuclear Phys., v. 16: 175-187, Apr. 1960.

A halflife $T_{\frac{1}{2}} = (7 \pm 2) \times 10^{-11}$ sec has been found for the first excited 330-kev state in Tl^{201}. The measurements have been performed in an electron-electron coincidence spectrometer by means of delayed technique. A new method to reduce the influence of energy dependent instrumental timedelays has been developed. The $K/L_I + L_{II}$ and $L_I + L_{II}/L_{III}$ ratios for the 330 kev transition have been measured by means of an iron yoke double focusing spectrometer. From these measurements the mixing ratio E2/M1 was found to be 2.2 ± 0.4. The transition matrix elements have been calculated and are compared with the corresponding matrix elements in Tl^{203}. (Contractor's abstract)

2815

Uppsala U. Inst. of Physics (Sweden).

INVESTIGATION OF INTERNAL BREMSSTRAHLUNG CROSS-SECTION WITH SPECIFIED ELECTRON AND

PHOTON ENERGIES, by J. E. Thun, B. G. Pettersson, and K. Siegbahn. [1960] [7]p. incl. diagrs. table, refs. (AFOSR-525) (AF 61(052)13) AD 254467
Unclassified

Also published in Nuclear Phys., v. 18: 131-137, Aug. 1960.

The internal bremsstrahlung from P^{32} is measured by a coincidence arrangement, where the electrons are detected in a lens spectrometer and the photons in a NaI(Tl) scintillation crystal. By selecting a certain energy in the β spectrometer it was possible to test the differential probability for the internal bremsstrahlung emission as given by the theory of Knipp and Uhlenbeck. The angle between the electron and photon is chosen to be 90°. The result shows good agreement for all electron energies chosen. (Contractor's abstract)

2816

Uppsala U. [Inst.] of Physics (Sweden).

A SMALL-ANGLE X-RAY SCATTERING APPARATUS USING A SPHERICALLY BENT CRYSTAL, by S. Hagström and K. Siegbahn. [1959] [19]p. incl. illus. diagrs. tables, refs. (AFOSR-526) [AF 61(052)13] AD 254468
Unclassified

Also published in Jour. Ultrastruc. Research, v. 3: 401-419, 1960.

A new method is described for curving a circular quartz lamina to give a point-focusing monochromator for x-rays. This monochromator has been used in an apparatus for studying small-angle scattering of x-rays. The distance between the scattering specimen and the focus can be varied continuously, the max distance being 850 mm.

2817

Uppsala U. Inst. of Physics (Sweden).

SMALL-ANGLE SCATTERING APPARATUS WITH A POINT-FOCUSING MONOCHROMATOR, by K. Siegbahn and S. Hagström. [1960] [5]p. incl. illus. diagrs. (AFOSR-850) [AF 61(052)13] Unclassified

Also published in X-ray Microscopy and X-ray Microanalysis; Proc. Second Internat'l. Symposium, Stockholm (Sweden) (1959), Amsterdam, Elsevier, 1960, p. 467-471.

An instrument for studying small-angle scattering of x-rays with a point-focusing monochromator has been designed and built. A circular lamina (diam 60 mm, thickness 0.5 mm) cut along the atomic planes $10\bar{1}0$ is bent between 2 concentric circular edges which gives a point-to-point focusing system. The x-ray tube has a focal area as seen under an angle of 6° of 0.14 x 0.10 mm^2. The atomic planes chosen give a Bragg angle of approx 80° for AlK_α in the first order, AgL_α in the second, and CrK_β, MnK_α, in the fourth order. The distance between the x-ray tube and the crystal is 1 m. Samples of powders or solutions are held in a cell with windows of thin mylar films. The distance sample-focus can be varied continuously from about 80 cm. The recording of the scattering curves can be made either photographically or by means of a counting tube. Investigations are made on Dow polystyrene latex with particle diam: 0.340, 0.264, and 0.138 μ. To get the first 10 rings of the 0.264 μ fraction with a distance sample-focus 850 mm, an exposure time of 3 hr was needed. The camera resolved the central first order of the 640A period of dry kangeroo-tail-tendon collagen and is capable of resolving consecutive orders of spacings as high as 10,000A. (Contractor's abstract)

2818

Uppsala U. Inst. of Physics (Sweden).

O+ LEVELS OF EVEN NUCLEI IN THE RARE-EARTH REGION, by I. Marklund, B. Van Nooijen, and Z. Grabowski. [1960] [33]p. incl. diagrs. tables, refs. [AF 61(052)13] Unclassified

Published in Nuclear Phys., v. 15: 533-565, Mar. 1960.

The quadrupole vibrations of beta type of deformed nuclei have been found in only a few cases in the heavy element region. A search was started in order to find such levels also in the rare-earth region. A O+ level of beta vibrational type at 685.0 kev was found in the deformed nucleus Sm^{152} by measuring conversion coefficients. Its corresponding O+ level of 2-phonon type was observed in Gd^{152} at 615.3 kev. The strongly deformed nucleus Er^{166} has a O+ level at 1460.4 kev now confirmed by angular correlation measurements. The 1087 kev level is Os^{188} and the 1267 kev level in the spherical nucleus Pt^{194} were also measured by angular correlations to have zero spins, indicating the same trend of the O+ levels as theoretically expected. (A second excited O+ level was found in Os^{188} at 1766 kev and in Pt^{194} at 1480 kev). When the beta and gamma bands are known, the theoretical and experimental rotational-vibrational coefficients can be compared: $B^{theory} = kB^{exp}$. A k-value of 2-4 is found indicating a weaker coupling than that theoretically expected. The experimental trend of levels in even nuclei with A = 50 - 250 is discussed, and some spin assignments are proposed. (Contractor's abstract)

2819

Uppsala U. Inst. of Physics (Sweden).

ANGULAR CORRELATION MEASUREMENTS IN Ba^{136}, by Z. Grabowski, S. Gustafsson and others. [1960] [10]p. incl. diagrs. tables, refs. [AF 61(052)13] Unclassified

Published in Nuclear Phys., v. 20: 159-168, Oct. 1960.

The angular correlation of cascading transitions between levels in Ba^{136} excited from Cs^{136} has been inventigated with an automatic gamma-gamma directional

correlation apparatus and with an electron-gamma correlation apparatus. The measured cascades are (kev): 1065-830, 1255-830, 337-1065 and 270-1065. They give the following spins of energy levels in Ba^{136} (kev(I, π)): 830(2+), 1900(4+), 2090(4+), 2170(5+) and 2240(6+). (Contractor's abstract)

2820

Uppsala U. Inst. of Physics (Sweden).

THE DECAY OF Ir^{194}, by J. Kern and G. Bäckström. [1960] [20]p. incl. diagrs. tables. [AF 61(052)13] Unclassified

Published in Nuclear Phys., v. 19: 461-481, Nov. 1960.

The decay of Ir^{194} has been investigated by means of a double focusing spectrometer, mostly by the photoelectron technique. A total of 32 transitions has been observed, and their energies and intensities have been measured. An internally converted transition of 1480 kev, for which no gamma ray could be detected, showed that a O+ state of this energy is populated. The log ft values for the beta branches showed that all the 18 levels excited are of even parity. By comparison of the measured gamma intensities with the conversion intensities of corresponding transitions in the decay of Au^{194}, spin values could be assigned for many levels. Evidence for a new O+ state at 1547 kev was obtained in this manner. Indications were found for EO admixture in competition with M1 and E2 multipolarities. A state at 923 kev may be interpreted as the 3+ level in the asymmetric rotor theory. (Contractor's abstract)

2821

Uppsala U. Inst. of Physics (Sweden).

THE DECAY OF As^{76} TO Se^{76}, by G. Bäckström and I. Marklund. [1960] [17]p. incl. diagrs. tables, refs. [AF 61(052)13] Unclassified

Published in Arkiv Fysik, v. 17: 393-409, 1960.

The gamma rays have been investigated by means of a double focusing spectrometer and a scintillation apparatus. Transitions of the following energies (kev) and relative intensities were found: 559.28 ± 0.10 (100), 657.36 ± 0.15 (14.1), 767.9 ± 2 (0.17), 869.1 ± 2 (0.24). 1216.0 ± 0.4 (9.7), 1228.7 ± 0.5 (2.3), 1438.3 ± 1.0 (1.2), 1453.5 ± 1.4 (0.54), 1788.6 ± 1.2 (0.71), 2097.2 ± 1.0 (1.32), 2111.8 ± 1.2 (0.73), 2433.6 ± 3 (0.05), 2656.1 ± 1.5 (0.077). Coincidence spectra were taken with two NaI(Tl) detectors, and the results were analyzed quantitatively. The decay scheme proposed involves levels at 559.3, 1216.6, 1788, 2112, 2434, and 2656 kev. The highest excited state is now known to have the spin of 3, and the ft-value as well as the presence of a detectable ground state transition indicate that the parity is odd and that the level should be considered as produced by octupole vibration. (Contractor's abstract)

2822

Uppsala U. Inst. of Physics (Sweden).

INTERACTION OF 560-MEV NEGATIVE π-MESONS WITH EMULSION NUCLEI, by A. Frisk, S. Nilsson and others. [1960] [14]p. incl. diagrs. tables, refs. (Sponsored jointly by [Air Force Office of Scientific Research under AF 61(052)13] and Swedish Atomic Research Council) Unclassified

Published in Arkiv Fysik, v. 19: 69-82, 1961.

Interactions of 560-mev negative pions with emulsion nuclei have been investigated. During the investigation 4454 stars have been found by area scanning. These yield an interaction mean free path of processes including absorption, charge exchange scattering and inelastic scattering of 28 ± 2 cm. Moreover, 485 stars have been analyzed in detail. The frequency of stars with charged pions is 33 ± 4% where those with no heavy prong are excluded. The average kinetic energy of pions from stars with 1 negative pion is 176 ± 20 mev. A marked correlation exists between the pion energy and the angle of emission. Eight events with 2 charged pions and 10 with 1 positive pion have been found. A rough estimate gives a fraction of events with charged pion production of 7 ± 4%. (Contractor's abstract, modified)

2823

Uppsala U. Inst. of Physiology (Sweden).

APPLICATION OF THE VOLTAGE CLAMP TO THE ELECTRO-HYDRAULIC NERVE ANALOG, by T. Teorell. [1960] [18]p. incl. diagrs. refs. (AFOSR-TN-60-1440) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)363, Rockefeller Foundation, and Swedish Medical Research Council) AD 253938 Unclassified

Also published in Acta Soc. Med. Upsaliensis, v. 65: 231-248, 1960.

The voltage clamp concept, which is effectively used for analyses of the fundamental processes in nerve excitation, has been employed on the electrokinetic membrane/electrolyte system (the membrane oscillator) previously described by the author. This system is here called the electro-hydraulic nerve analog. The results are centered around the current response, when the membrane potential has been changed in steps to various constant levels. It has been found that the response patterns in many essential details are in conformance with those actually obtained on nerves by other authors. Several discrepancies, however, are discussed. The interpretation of the voltage clamp patterns is obtained from straightforward application of Ohm's law as the current response simply reflects the time varying change in the internal membrane resistance. These changes are the results of the concurrent driving forces arising from electrochemical and hydrostatic pressure gradients. No specific permeability changes of the present ions are required (the analog works with the assumption of a single salt like NaCl). The characteristic response referred to as sodium inward current has no specific significance in the present

analog. The results suggest that alternative explanations of voltage clamp data may be possible when analyzing actual nerve experiments. (Contractor's abstract)

2824

Utah U. Dept. of Chemical Engineering, Salt Lake City.

IGNITION OF COMPOSITE PROPELLANTS (Abstract), by N. W. Ryan. [1960] [2]p. [AF 49(638)170] Unclassified

Presented at Second AFOSR Contractors' meeting on Solid Propellant Combustion, Atlantic Research Corp., June 7-8, 1960. (AFOSR-TN-60-663; AD 239150)

Work is continuing on ignition of composite propellants by convective heating (see item no. 2147, Vol. III). In the technique employed, hot gas is generated in a shock tube and exhausted to the atmosphere at controlled rates through a channel. Propellant forms part of the wall of the channel. Ignition time as detected by a photocell is correlated with heat flux. The heat flux is calculated from heat transfer parameters determined with the same experimental apparatus, but with a platinum thin-film resistance thermometer in place of the propellant. Ignition tests of this kind are being carried out in larger apparatus so that the ignition process can be photographed. Problems in the prediction of heat flux, which follow a more complex pattern than was previously reported, have been encountered. The extensive heat transfer study has required solving Fourier's equation in a manner that permits evaluating heat flux as a function of time from an arbitrary temperature-time relationship. Such a solution has been produced in integrated form. It assumes that the temperature-time trace can be divided into a series of straight line segments. The accuracy of the solution for a particular problem will depend on the number of segments chosen. A modification of the solution accommodates the case of heating by gases behind a shock wave, in which case there is an instantaneous initial temperature rise. The role of flame spread in the over-all ignition process has been briefly investigated with a polysulfide-ammonium perchlorate propellant. Slabs of propellant were cemented to an inert base. The edges were lightly restricted; the top faces were freshly cut surfaces. The slabs were ignited at one of the short ends. The following observations were made for burning at atmospheric pressure: (1) With the thinner slabs (to 1/8 in.), burning occurred on a flat surface forming an angle of approx 45° with the unburned top surface. The rate of flame spread, the speed with which the flame edge progresses along the unburned top surface, is the normal burning rate times the secant of this angle, or a about 1.4 times the normal burning rate. (2) Thicker slabs (1/4 in. to 1/2 in.) were ignited near the base of the vertical edge. The flame spread to the top surface, where it established the canted burning surface observed on thin slabs. The canted burning surface grows at the expense of the original vertical burning surface until the latter disappears. While both burning surfaces are present, the two corresponding jets of hot gases and particles are quite distinct. (3) The same behavior was observed for slabs cemented to a thin sheet of copper instead of an insulating material. One-eighth in. slabs were similarly burned in a window bomb at 250 psi. The canted burning surface was again observed, again at an angle of about 45° to the unburned surface. The normal burning rate and the rate of flame spread appear to have the same pressure dependence. The study of flame spread will be extended to include other propellants. Measurements of the angle between burning and unburned surface will be made. An exhaustive study is not planned, motivation being diminished by the tentative conclusion that flame spread is too slow to be a major factor in the over-all ignition process.

2825

Utah U. Dept. of Electrical Engineering, Salt Lake City.

SPECTRAL ANALYSIS OF THE IMPACT OF ULTRA VELOCITY COPPER SPHERES INTO COPPER TARGETS, by J. S. Clark, R. R. Kadesch, and R. W. Grow. Sept. 1, 1959, 52p. incl. illus. diagrs. tables. (Technical rept. no. 16) (AFOSR-TN-60-13) (AF 49-(638)462) AD 232499; PB 146005 Unclassified

Spectrographic observations were made for Cu projectiles impacting into Cu targets in various controlled atmospheres. Atomic Cu lines are the predominant feature of the impact flash of Cu-to-Cu impacts in a medium of Ar. Since a Cu line with a 7.1 ev excitation energy is excited in an Ar atmosphere, an energy of at least this magnitude is available for excitation of Cu atoms. Results indicate that in Ar, the flash is produced by micron-size Cu particles ejected from the target, some with velocities no less than 6-7 km/sec and heated by the medium. A collision process between Cu atoms evaporated from the heated spray particles and atoms of the Ar atmosphere can account for the observed Cu lines. In a medium of H, the impact flash is dimmer by at least 2 orders of magnitude, giving a smooth spectral contour with no detectable line structure. However, no obvious black body temperature is obtainable from the contour of this light emission in H. The relative velocity between Cu atoms and H molecules required to produce Cu lines is greater than 20 km/sec in a collision process. The reduced size of the flash in H indicates that the particles responsible for the flash are smaller than those producing the flash in Ar. (Contractor's abstract)

2826

Utah U. Dept. of Electrical Engineering, Salt Lake City.

ANALYSIS AND DEVELOPMENT OF A LIGHT-GAS GUN FOR ACCELERATING PELLETS TO HYPERSONIC VELOCITIES, by K. E. Boyd, R. W. Grow and others. Oct. 15, 1959, 84p. incl. illus. diagrs. tables. (Technical rept. no. 17) (AFOSR-TN-60-81) (AF 49(638)462) AD 235436 Unclassified

A light-gas gun employing hydrogen as a driving gas and using a piston-type compression cycle has been developed and fired in 2 different configurations under a variety of firing conditions. Pellets weighing 1 g have been launched through a velocity range from 7,000 ft/sec to 27,300 ft/sec. The high velocity of 27,300 ft/sec has not been verified because of the damage

suffered by the gun when fired at the conditions required to achieve this velocity. Rather than risk destroying the gun by attempting to verify the highest velocity achieved, emphasis was placed on gaining data at reduced energy levels to study the launching cycle in a manner to gain maximum knowledge. Data are presented and analyzed of a gun having a compression tube length of 92 in. and a bore of 2.38 in., and designed to launch pellets either parallel to the longitudinal axis of the gun or perpendicular to the longitudinal axis. A study and analysis of the piston motion is made and a basis for assuming a shock-wave compression process is determined. Equations describing pressure ratio and temperature ratio across a compression wave and a reflected wave are developed and a comparison of a shock-wave compression process to a reversible-adiabatic compression process is made. (Contractor's abstract)

2827

Utah U. Dept. of Electrical Engineering, Salt Lake City.

VELOCITY AND SIZE DISTRIBUTION OF IMPACT SPRAY PARTICLES, by R. E. Blake, R. W. Grow and E. P. Palmer. May 20, 1960, 44p. incl. illus. diagrs. tables, refs. (Technical rept. no. 19) (AFOSR-TN-60-993) (AF 49(638)462) AD 245112 Unclassified

Steel and pyrex spheres having a diam of 3/16 in. were accelerated with a 220 caliber smooth-bore gun to a velocity of 2.0 km/sec. These spheres were impacted on a target of a composition of the same type as the sphere. The luminous spray resulting from the impact was detected by means of photocircuits which produced a voltage that was recorded by an oscilloscope camera. Maximum measured initial spray velocities for the steel to steel impacts varied between 8.5 km/sec and 10.3 km/sec, and a measured average velocity between 2 points for glass to glass impacts was in excess of 20 km/sec. The particle radius of the steel spray was calculated from drag data to be between 0.18 and 1.02μ. In order to separate the impacting spray particles, a high speed motor was used to rotate a polished aluminum disk at a velocity of 32,000 rpm. The velocity distribution of the spray particles in the steel to steel impacts was observed to have 2 discrete velocity classes; 1 at the faster velocity of approx 9 km/sec and another moving much slower in respect to the initial time of impact. This 2nd discrete velocity class was not observed in the glass to glass impacts. Particles moving at these discrete velocities were of random size. The distribution of the crater size at various angular positions is presented.

2828

Utah U. Dept. of Electrical Engineering, Salt Lake City.

HYPERVELOCITY IMPACT SPRAY PARTICLES, by W. H. Clark, R. R. Kadesch and R. W. Grow. May 1, 1960, 90p. incl. illus. diagrs. tables, refs. (Technical rept. no. 18) (AFOSR-TN-60-990) (AF 49(638)462) Unclassified

A spray of small fast particles is ejected from a fast metal-to-metal impact. The velocity of the fastest spray particles previously observed, measured relative to the more massive body involved in the impact, was twice the impacting velocity. Under certain conditions very much faster spray particles appear. When a 3/16 in. diam carbon steel sphere, with a velocity of 2 km/sec, impacted on a massive steel target in air at 8 cm mercury pressure, spray particles of about 0.5μ diam left the impact at velocities up to 15 km/sec. The velocity was measured by a time of flight technique. The effect of varying pellet and target material and the atmosphere on the characteristics of the spray particle was investigated. All 3 variables have strong and complicated effects. A partial theory of the acceleration of spray particles was developed. Tests made on impacts of special geometry confirmed the theoretical predictions. These fast spray particles will be useful as artificial meteors for research purposes. It is demonstrated that the faster spray particles observed are luminous due to the same process whereby the average visual meteor leaves a luminous trail. (Contractor's abstract)

2829

Utah U. Dept. of Electrical Engineering, Salt Lake City.

INVESTIGATION OF THE FEASIBILITY OF AN ELECTROSTATIC ACCELERATOR FOR ACCELERATING MICRON-DIAMETER PARTICLES. I. VAN DE GRAAFF GENERATOR. II. CHARGING OF MICRO PARTICLES, by G. K. Jesperson, D. W. Reid and others. Preliminary rept. Nov. 15, 1960 [126]p. incl. illus. diagrs. refs. (Technical rept. no. 20) (AFOSR-719) (AF 49-(638)462) AD 257946 Unclassified

A Van de Graaff generator which charges to 600,000 v and delivers 70 microamps when negatively charged and 10 microamps at 475,000 v when positively charged was built. Charge is generated by ionization in the vicinity of the lower pully and transferred from the belt to the oblate by means of ionized air which is due to the potential between belt and oblate. Loss of charge from the belt other than that to the oblate and the maximum surface charge density on the belt were calculated. An equivalent circuit which is a function of belt speed only was obtained and given good agreement with experimental voltage measurements at low belt speeds. An electrostatic particle-accelerator using the Van de Graaff generator was built to accelerate carbonyl-iron spheroids having an average diameter of 3 microns for hypervelocity impact studies. The particles are first charged and then accelerated by the generator. A method for measuring the charge and velocity of the particles is discussed. (Contractor's abstract)

2830

Utah U. [Dept. of Metallurgy] Salt Lake City.

OBSERVATION OF VAPORIZATION ACCOMPANYING ULTRA-HIGH VELOCITY IMPACT, by R. W. Bartlett. Jan. 4, 1960 [24]p. incl. illus. diagrs. (AFOSR-TN-60-327) (AF 18(603)100) AD 237546; PB 148013 Unclassified

The study of the behavior of metals under ultra-high velocity impact which emphasizes the vaporization and

penetration of metals is presented. Jets from shaped charges and discreet particles accelerated by high explosives were used as projectiles. Studies were made at velocities up to 8.5 km/sec using a variety of target and projectile metals, i.e., aluminum, steel, lead and zinc. The explosive techniques employed were capable of generating velocities sufficiently high to produce target vaporization in many metals. These impact-generated vapors were sufficiently luminous for short periods of time to be photographed, and they exhibited considerable electrical conductance evidencing a high degree of ionization which decayed faster in air and various inert gases than in vacuum. Because of the high luminosity and the ionization of the impact-generated metal vapors or plasmas, high-speed framing camera techniques and electrical conductivity measurements were employed. Small quantities of the condensed vapors were collected and analyzed quantitatively to determine the ratios of the projectile or jet to target metals in the vapor condensate as a function of impact velocity. In most cases mixtures of metal oxides were indicated but the x-ray diffraction patterns did not permit conclusive identification of specific compounds. Some condensation of reduced metal also was observed, and a substitutional solid solution alloy, alpha brass, was produced by the simultaneous condensation of copper and zinc vapors originating from different targets impacted in tandem. (Contractor's abstract)

2831

Utah U. [Dept. of Metallurgy] Salt Lake City.

FRAMING CAMERA OBSERVATIONS OF ULTRA-HIGH VELOCITY PENETRATION IN TRANSPARENT TARGETS AND A MECHANISM FOR CRATER EXPANSION, by R. W. Bartlett and R. T. Keyes. Mar. 31, 1960 [18]p. incl. illus. diagrs. tables. (AFOSR-TN-60-851) (AF 18(603)100) AD 241898; PB 150167 Unclassified

Also published in Proc. Fourth Symposium on Hypervelocity Impact, Eglin Air Force Base, Fla., (Apr. 26-28, 1960), Eglin, Air Proving Ground Center, Sept. 1960, paper no. 30. (APGC-TR-60-30(III)).

A mechanism is presented for cratering in metal targets impacted by shaped charge jets in which the hole diam is expressed as a function of striking velocity jet diam, densities of target and jet, and the yield strength of the target and is compared with measured hole diameters in several different metals struck by iron, copper and aluminum jets at various velocities. The same mechanism is expanded to account for the dynamics of crater formation, i.e., the lateral rate of expansion of the crater as a function of forward penetration of the crater. Theoretical curves are compared with experimental results obtained by means of μsec framing camera techniques for steel jets penetrating several transparent substances of different densities. Some additional results pertaining to vaporization in ultra-high velocity impact also are given. (Contractor's abstract)

2832

Utah U. [Dept. of Metallurgy] Salt Lake City.

DETONATION-GENERATED PLASMAS, by A. Bauer, M. A. Cook, and R. T. Keyes. [1960] [18]p. incl. illus. diagrs. refs. (AFOSR-705) (AF 18(603)100) AD 258123 Unclassified

Also published in Proc. Roy. Soc. (London), v. 259A: 508-517, Jan. 24, 1961.

Recent photographs, taken at the rate of one million per sec, are presented of the brilliantly luminous, highly ionized gas clouds (detonation-generated plasmas) emitted from free surfaces of detonating explosives. It is demonstrated that the plasmas may be extruded and conveyed readily through thin-walled tubing, and that they may be exploded rapidly upon striking solid surfaces or upon sudden release of confinement under high compression. Means of separating and differentiating the shock waves and plasmas associated with the detonation of condensed explosives are illustrated. Examples of plasma explosions are presented illustrating the particular metastable character of these plasmas. Measurements of the velocity-conductivity-density relations in the plasmas are presented and their resemblance to metals discussed.

2833

Utah U. [Dept. of Metallurgy] Salt Lake City.

IONIZATION IN THE SHOCK INITIATION OF DETONATION, by R. B. Clay, M. A. Cook and others. [1960] [29]p. incl. illus. diagrs. tables, refs. (Sponsored jointly by Air Force [Office of Scientific Research] under AF 18(603)100 and Bureau of Ordnance under Nord-17371) Unclassified

Published in Proc. of the Third ONR Symposium on Detonation, Princeton U., N. J. (Sept. 26-28, 1960), v. 1: 150-163, 1960.

Conductance-distance (or time) curves measured by the parallel and perpendicular probe methods in receptors of the modified card-gap or SPHF plate method are presented and compared with corresponding pressure-distance curves obtained by the aquarium method. Results show that the initiation of detonation by shock correlates directly with an ionization pulse observed to propagate in the predetonation regime. It is shown that the ionization is the major factor in the initiation of detonation, although the shock wave is also an important factor. (Contractor's abstract, modified)

2834

Utah U. [Dept. of Physics] Salt Lake City.

STUDIES IN DIFFRACTION. PART A. WIDE ANGLE DIFFRACTION OF A HALF PLANE. PART B. DIFFRACTION PATTERNS OF SLITS OF VARYING WIDTHS, by M. S. Tavenner. Dec. 1960 [108]p. incl. illus. diagrs. tables, refs. (AFOSR-TN-60-1487) (AF 49-(638)799) AD 249245 Unclassified

Precision photometric measurements ranging over a relative intensity of 10^8 were made of the light intensities for unpolarized, parallel-polarized, and perpendicular-polarized light in the shadow of a half plane. Direct comparison of the results with Sommerfeld theory show that in general, the experimental intensities are less than the theoretical curves. It was found that the ratio of light polarized in the perpendicular plane of polarization to the parallel light was much less than the theoretical ratio, increasing to a value between 2 and 3 at diffracting angles of 30-40° and tending to decrease for larger angles. Results of the calculations of Sommerfeld's equation by means of a digital computer are included in an appendix. Calculations are made for different incident angles in increments of 5° from 5° to 175° and for each angle of diffraction for the different incident angles. Detailed Fresnel diffraction patterns of a single slit were precisely measured for a series of slit widths which show the pattern variation with width. This series, giving almost continuous change from Fraunhofer to Fresnel-type diffraction patterns, are the best achieved to date. Some double-slit measurements were also made of which one is shown. (Contractor's abstract, modified)

2835

Utah U. [Dept. of Physics] Salt Lake City.

SINGLE-SLIT FRESNEL DIFFRACTION PATTERNS (Abstract), by F. S. Harris, Jr., M. S. Tavenner, and G. R. Orme. [1960] [1]p. [AF 49(638)799] Unclassified

Presented at meeting of the Amer. Opt. Soc., Boston, Mass., Oct. 12-14, 1960.

Published in Jour. Opt. Soc. Amer., v. 50: 1131, Nov. 1960.

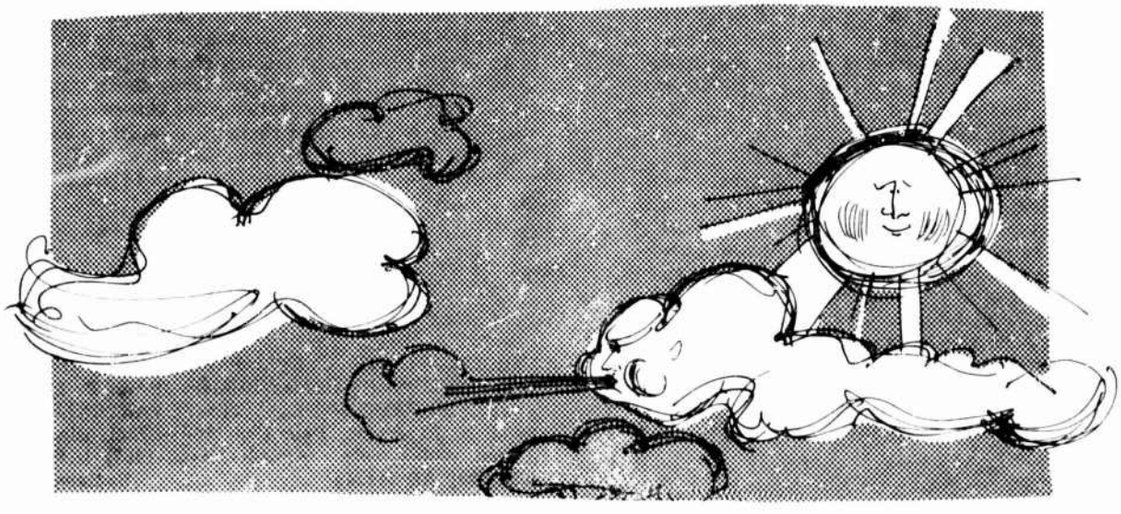
Detailed Fresnel diffraction patterns of a single slit have been measured precisely for a series of slit widths which show the pattern variation with width. The light source, electron multiplier photometer, and scanning mechanism, were improved for the present work. Light of 5461A from a mercury AH4 source was obtained using a grating monochromator. The source slit was 50 m from the photometer and the diffraction slit 20 m from the source. The diffracting slit was moved laterally, and the changing intensity of the pattern was measured by the fixed 1P21 electron multiplier tube photometer and recorded on the strip chart of a Leeds and Northrup Speedomax recorder. Intensity fluctuations of the light source were compensated by taking the ratio of the diffracted intensity to that of the source by means of the recorder servomechanism. The slits, varying in width from 0.5 mm-32 mm, were constructed, and the patterns were measured. Some double-slit graphs of the patterns were also made. The great advantage of this method over the photographic method is demonstrated. Discussion of the comparison of the experimental patterns with theory is given.

2836

Utah U. Inst. for the study of Rate Processes, Salt Lake City.

KINETICS OF CHEMICAL REACTIONS, by G. R. Hill and Y.-C. Fu. Final rept. Nov. 30, 1960 [71]p. incl illus. diagrs. tables, refs. (AFOSR-114) (AF 49(638)-28) AD 251077 Unclassified

The kinetics and mechanism of diborane (B_2H_6) and carbon monoxide-borane (BH_3CO) pyrolysis were investigated. An attempt was made to verify the existence of BH_3 by means of the infrared spectrometer; the absorption peaks of the intermediates were detected by a differential infrared technique. A study was made of the infrared spectra of carbon monoxide borane, diborane, and other boron hydrides to obtain kinetic data. The mechanisms of BH_3CO reactions were investigated. The enthalpies of activation and rate constants for 2 reactions which occur in the first and second order BH_3CO rearrangement reactions were determined. The catalytic effects of different surfaces were investigated.



2837

Veterans Administration Hospital. Dept. of Neurology, Boston, Mass.

COLORS OF ALL HUES FROM BINOCULAR MIXING OF TWO COLORS, by N. Geschwind and J. R. Segal. [1959] [1]p. (AFOSR-TN-60-1056) [ISSA-60-1] AD 243532 Unclassified

Also published in Science, v. 131: 608, Feb. 26, 1960.

The recent study by Land on the perception of colors resulting from appropriate mixtures of 2 colors or of 1 color and light from an incandescent lamp is described. In an "image situation", colors of all hues may result from such mixtures. The findings presented demonstrate that the mixing which Land accomplished by superimposing 2 projected images on a screen can be achieved when the 2 color separation images are presented simultaneously but separately to the 2 eyes. (Contractor's abstract)

2838

Vienna U. Inst. for Theoretical Physics (Austria).

THE SIGMA-NEUTRON INTERACTION, by G. Eder. Nov. 23, 1959, 4p. incl. diagr. (Scientific note no. 2) (AFOSR-TN-60-25) (AF 61(052)265) AD 232068; PB 146713 Unclassified

The potential between a Σ-particle and a neutron due to exchange of pions is calculated in a static theory. A strangeness and isobaric spin conserving interaction is considered. Second and fourth order terms in the coupling constant are evaluated. It can be shown, that the singlet spin potential is more attractive than the triplet spin potential, in agreement with experimental evidence. (Contractor's abstract)

2839

Vienna U. Inst. for Theoretical Physics (Austria).

ON THE RENORMALIZATION OF BETA COUPLING, by K. Baumann and A. Hold. Nov. 17, 1959 [4]p. (Scientific note no. 1) (AFOSR-TN-60-26) (AF 61(052)-265) AD 232391; PB 146712 Unclassified

The renormalization of the vector and axial vector current is calculated for a single Dirac field which is coupled to itself. A nonlocal Fermi-type interaction is introduced which has been treated by Abrikosov and others (Phys. Rev., v. 111: 321, 1958). In the limit of small nonlocality the renormalization can be performed nonperturbationally. The vector nonrenormalization and an axial vector renormalization factor are found to be greater than one. (Contractor's abstract)

2840

Vienna U. Inst. for Theoretical Physics (Austria).

THE TWO MESON APPROXIMATION FOR THE REAL NUCLEON, by G. Eder. May 24, 1960, 13p. (Scientific note no. 3) (AFOSR-TN-60-710) (AF 61(052)265) AD 244301 Unclassified

Also published in Nuovo Cimento, Series X, v. 18: 430-442, Nov. 1, 1960.

The method of momenta proposed by F. Halpern (see Phys. Rev., v. 107: 1145, 1957 and item no. 1765, Vol. III) is applied to the description of the real nucleon state in the two meson approximation. The static model of Chew and Low for an extended source was used. It seems possible to get a weakly coupled model which gives a good value of f^2 and which fits rather well the sum rules for the pion nucleon scattering amplitudes. (Contractor's abstract)

2841

Vienna U. Inst. for Theoretical Physics (Austria).

THE TWO-BODY PROBLEM IN THE EXTREME RELATIVISTIC LIMIT, by W. Thirring and K. Baumann. June 10, 1960, 8p. incl. refs. (Scientific note no. 5) (AFOSR-TN-60-942) (AF 61(052)265) AD 242431; PB 150353 Unclassified

Also published in Nuovo Cimento, Series X, v. 18: 357-367, Oct. 16, 1960.

In view of the composite model for elementary particles the two-body problem is studied in the extreme relativistic limit. Spinless particle-antiparticle bound states are investigated for a single massless self-interacting Weyl field. High momenta are suppressed in a Lorentz invariant manner by introducing a heavy auxiliary boson. A Bethe-Salpeter equation is set up in the ladder approximation. The consequences of the continuity equation are studied in the same approximation and are shown to be fulfilled automatically only for scalar bound states. A new method is presented for solving the Bethe-Salpeter equation. A spectral ansatz is made for the wave function which leads to a one-dimensional integral equation for the weight function when the rest mass of the bound state is neglected. This integral equation is solved in the Fredholm approximation for a somewhat modified cut-off prescription in the scalar case. With the same restriction, the eigenvalue is found also in the pseudoscalar case. It is shown that the method of solution can be extended to any order in the rest mass of the bound state. (Contractor's abstract)

2842

Vienna U. Inst. for Theoretical Physics (Austria).

ON THE FERMI-YANG THEORY OF THE PION, by W. Thirring, K. Baumann, and P. G. O. Freund. June 10, 1960, 6p. (Scientific note no. 4) (AFOSR-TN-60-962) (AF 61(052)265) AD 247019 Unclassified

Also published in Nuovo Cimento, Series X, v. 18: 906-913, Dec. 1, 1960.

A theory is proposed to reduce the strong interactions to the universal weak interaction by considering them as

high energy phenomena of the strongly energy dependent weak interaction. According to Fermi and Yang the pion is assumed to be a nucleon-antinucleon bound state. A Bethe-Salpeter equation is solved, the bound state wave function is normalized, and the pion-nucleon coupling-constant is calculated. The latter turns out to be of the order unity although a weak interaction between the fermions is used. (Contractor's abstract)

2843

Vienna U. Inst. for Theoretical Physics (Austria).

THE CONFORMAL INVARIANCE IN QUANTUM FIELD THEORY, by J. Wess. June 20, 1960, 24p. (Scientific note no. 6) (AFOSR-TN-60-1003) (AF 61(052)265) AD 242432; PB 150358 Unclassified

Also published in Nuovo Cimento, Series X, v. 18: 1086-1107, Dec. 16, 1960.

The properties of a conformal invariant quantum field theory are considered. A short discussion of the conformal group in 4 dimensions and of the topology, introduced into the pseudo-euclidean space by this group is given. With the help of the commutation relations the spectrum of the generators in the Hilbert-space is investigated. We find that the only possible discrete eigenvalue of P^2 and of the P^{ν}'s is zero and that the generator for scale transformations S has a continuous spectrum. The eigenfunctions of S in the x-representation are calculated, they form a complete set. The conservation laws valid in an invariant theory and the commutation relations predict a certain form of the conserved quantities expressed in terms of the energy-momentum tensor and of the coordinates. For scalar, spinor and vector fields the generators are derived by the action principle of Schwinger. (Contractor's abstract)

2844

Virginia U. Dept. of Mathematics, Charlottesville.

FIXED POINT FREE INVOLUTIONS AND EQUIVARIANT MAPS, by P. E. Conner and E. E. Floyd. [1960] [40]p. incl. refs. (Technical note no. 18) (AFOSR-TN-60-719) (AF 49(638)72) AD 256043 Unclassified

Also published in Bull. Amer. Math. Soc., v. 66: 416-441, Nov. 1960.

A study is made on involutions without fixed points and equivariant maps connecting such points. Questions arising from results of other investigators concerning the existence of equivariant maps are answered. The relationship between these maps and cat X/T and the cohomology ring $H^*(X/T;Z_2)$ is explained.

2845

Virginia U. Dept. of Mathematics, Charlottesville.

NON-OBSTRUCTING SETS AND RELATED MAPPINGS, by G. T. Whyburn. Aug. 1960, 8p. (Technical note no. 19) (AFOSR-TN-60-902) (AF 49(638)72) AD 256045 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 46: 1244-1247, Sept. 1960.

In earlier papers (see Mem. Amer. Math. Soc., v. 1: 19, 1950 and item no. VRU. 01:005, Vol. II) the type of set which separates no region in a locally connected space has been found to play a basic role, particularly when it constitutes the singular or exceptional set of points for a mapping. A further study of such sets is made along with their connection with open and related mappings on sets having near-manifold structure. All spaces are to be assumed separable and metric as well as locally connected generalized continua at least, i.e., connected, locally connected and locally compact as well as separable and metric. By a region in a space X is meant a connected open subset of X. A set X is said to be almost uniformly locally connected provided that if C is any conditionally compact subset of X and $\epsilon > 0$, there exists $\delta > 0$ such that any two points x, $y \in C$ with $\rho(x,y) < \delta$ lie together in a connected subset of X of diam $< \epsilon$. The definition gives the following results: (1) Q-sets are finitely additive; (2) any closed subset of a Q-set is a Q-set; (3) a closed non-dense set Q is a Q-set if and only if each $q \in Q$ lies in an arbitrarily small region R in X such that $R - R \cdot Q$ is connected; and (4) if X is an n-dimensional manifold, any closed subset of X of dimensionality $\leq n - 2$ is a Q-set. Theorems and corollaries are given.

2846

Virginia U. Dept. of Mathematics, Charlottesville.

CONVERGENCE IN NORM, by G. T. Whyburn. Oct. 1960 [6]p. (Technical note no. 20) (AFOSR-TN-60-1194) (AF 49(638)72) AD 256046 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 46: 1614-1617, Dec. 1960.

Let X, Y, be metric, and $f_n: X \to Y$ a sequence of onto maps converging to an onto map $f: X \to Y$. The properties of f under the additional condition that the norms $N(f_n) = \sup\{\text{diam } f_n^{-1}(y) | y \in Y\} \to 0$ are determined. The following general results are stated: (a) X compact Y locally connected, convergence uniform, and $N(f_n) \to 0$ imply f is monotone. (b) X, Y locally connected generalized continua, X cyclic, convergence pointwise, and $N(f_n) \to 0$ imply Y is cyclic. (c) If $X = Y = S^2$, then all monotone onto maps, and only monotone onto maps, can be uniform limits of consequences of onto maps with $N(f_n) \to 0$. (d) X, Y compact, convergence uniform, and the sequence $\{f_n\}$ uniformly approximately open implies f is a homeomorphism.

2847

Virginia U. Dept. of Mathematics, Charlottesville.

DIFFERENTIABLE INVOLUTIONS, by P. E. Conner and E. E. Floyd. Sept. 1960, 9p. (Technical note no. 21) (AFOSR-TN-60-1252) (AF 49(638)72) AD 256486 Unclassified

A scheme is given for classifying the differentiable involutions without fixed points on closed manifolds according to equivariant cobordism type. The assumptions of differentiability are used in studying transformation groups. An equivariant cobordism theory is presented for fixed point free involutions ignoring orientations.

2848

Virginia U. [Dept. of Mathematics] Charlottesville.

DEVELOPMENTS IN TOPOLOGICAL ANALYSIS, by G. T. Whyburn. [1960] [14]p. (Technical note no. 22) (AFOSR-52) (AF 49(638)72) AD 256487 Unclassified

Also published in Fundamenta Math., v. 50: 305-318, 1962.

In a recent paper (Proc. Amer. Math. Soc., v. 87: 177-181, 1961) Porcelli and Connell have given classical results concerning power series developments of functions of a complex variable by topological arguments. In the present paper, these results and other recent results concerning the classical theory of functions of a complex variable secured by topological methods, are fitted into a natural sequence.

2849

Virginia U. [Dept. of Mathematics] Charlottesville.

DIFFERENTIABLE PERIODIC MAPS, by P. E. Conner and E. E. Floyd. [1960] 115p. refs. (Technical note no. 23) (AFOSR-1016) (AF 49(638)72) AD 262841 Unclassified

Fiber bundles are classified into corbordism groups by means of differential manifolds. Clearly defined differentiable periodic maps are presented. Fixed-point free involutions are applied to specific cases. An appendix describes a different approach to the subject.

2850

Virginia U. [Dept. of Mathematics] Charlottesville.

NORMS FOR OPEN MAPPINGS, by G. T. Whyburn. [1959] [8]p. (AF 49(638)72) Unclassified

Published in Jour. London Math. Soc., v. 35: 302-309, July 1960.

If X and Y are metric spaces and $f(X) = Y$ is a mapping, it is possible to understand by the norm $N(f)$ of f the least upper bound of the diameters of point inverses $f^{-1}(y)$ for $y \in Y$. For some spaces X and some classes of mappings T there will exist a positive constant $d(X, T)$ such that any mapping of class T operating on the space X necessarily has norm $\geq d(X, T)$. In case X is a circle and T is the class of non-topological open (or interior) mappings, for example, it readily follows that $d(X, T) = r\sqrt{3}$ may be taken, where r is the radius of X. It is also easy to obtain such a result for the same T when X is an arbitrary simple closed curve. The main objective of the present work is to prove such a conclusion in case X is a plane simple closed curve and obtain the constant as a function of the size of circular disks enclosed by X. This theorem is then applied to prove the existence of a constant $d(X, T)$ where X is a 2-dimensional manifold and T is the class of all light open mappings which are of degree > 1 on an everywhere dense set in the range space. Thus an extension of the 2-dimensional case of the well-known theorem of Newman (Quart. Jour. Math., Series 1, v. 2: 1-8, 1931) concerning periodic mappings on manifolds is obtained.

2851

Virginia U. [Dept. of Mathematics] Charlottesville.

RETRACTION PROPERTIES OF THE ORBIT SPACE OF A COMPACT TOPOLOGICAL TRANSFORMATION GROUP, by P. E. Conner. [1959] [16]p. incl. refs. (AF 49(638)72) Unclassified

Published in Duke Math. Jour., v. 27: 341-357, 1960.

This paper is motivated by Floyd's result (Amer. Jour. Math., v. 73: 363-367, 1951) to the effect that whenever a finite group operates as a group of topological transformations on a compact finite dimensional absolute neighborhood retract (ANR), then the orbit space is also an ANR. The question was later raised about the possibility of extending this theorem to the action of compact Lie groups. In the present work, the problem is not solved completely, but the conjectured generalization of Floyd's theorem is reduced to what at first appears to be an unrelated conjecture about compact connected simple Lie groups. Conjecture I. If (G, X) denotes a compact Lie group acting on a compact connected finite dimensional ANR, and if (G, X) has a finite number of conjugacy classes of isotropy subgroups, then the orbit space X/G is also an ANR. Furthermore, if X is an absolute retract (AR), then so is the orbit space X/G. Conjecture II. For every compact connected simple Lie group G there is a transformation group (G, M) with a finite number of conjugacy classes of isotropy groups on a compact space M such that (G, M) has no stationary points and such that $H^t(n; Z) \approx H^t(M/G; Z) = 0$ for $0 \leq t < n$. The fact that II implies I is not immediately obvious, and this paper is devoted to proving this point.

2852

Virginia U. [Dept. of Physics] Charlottesville.

EXPERIMENTAL CALIBRATION OF SCINTILLATION

PULSE HEIGHTS OF THIN CsI CRYSTALS, by D. C. Worth and G. R. Haste. [1959] [2]p. incl. diagrs. table. [AF 49(638)176] Unclassified

Published in Rev. Scient. Instr., v. 31: 169-170, Feb. 1960.

The pulse-height response of 3 thin CsI crystals has been determined for protons $B^{10}(d, p)$ and $C^{12}(d, p)$ reactions, using Al foils to vary the energy of the incident protons. Three points on the range-energy curve for CsI have been determined and compared with the range-energy curve for silver.

2853

Virginia U. Dept. of Physics, Charlottesville.

PHOTONEUTRON CROSS SECTIONS OF COBALT AND MANGANESE, by P. A. Flournoy, R. S. Tickle, and W. L. Whitehead. June 1960 [21]p. incl. diagrs. tables, refs. (AFOSR-TN-60-658) (AF 49(638)176) AD 238123; PB 148346 Unclassified

Also published in Phys. Rev., v. 120: 1424-1428, Nov. 15, 1960.

The total photoneutron yields of Mn^{55} and Co^{59} were carefully measured from threshold to approx 30 mev. Analysis of these data using the Leiss-Penfold matrix indicates that the cross sections for both elements show a splitting in the giant resonance region in accord with the predictions of the classical hydrodynamic model. The Mn^{55} peaks occur at energies of 16.8 ± .25 mev and 19.75 ± .25 mev corresponding to cross sections of 90 mb and 77 mb, respectively. Co^{59} maxima occur at 16.75 ± .25 mev and 18.75 ± .25 mev with cross sections of 109 mb and 92 mb. The cross sections $\sigma(\gamma, n) + \sigma(\gamma, 2n) + \sigma(\gamma, np) + \ldots$ integrated to 25 mev are 627 mev-mb for Mn^{55} and 709 mev-mb for Co^{59}. Breit-Wigner resonance lines were fitted to both cross sections and the intrinsic quadrupole moments determined from these fits are +.78 ± .10 barns for manganese and +.76 I .11 barns for cobalt. (Contractor's abstract)

2854

Virginia U. Dept. of Physics, Charlottesville.

ENERGY SPECTRUM OF THE PHOTONEUTRONS FROM GOLD, by R. F. Askew and A. P. Batson. July 1960 [18]p. incl. diagrs. tables. (AFOSR-TN-60-796) (AF 49(638)176) AD 239501; PB 148223 Unclassified

Also published in Nuclear Phys., v. 20: 408-416, Nov. 1960.

The energy spectrum of the neutrons produced at 90° to a gold target bombarded with 55 mev bremsstrahlung was measured. Nuclear emulsions were used to detect the photoneutrons. The spectrum shows two peaks. The large peak at 1.25 mev can be interpreted as due to the statistical decay of the compound nucleus. The smaller peak at about 5.5 mev is assumed to come from a "direct" transition, as described by the Wilkinson model. In the appendix a new method is presented for the calculation of the corrections involved for those proton recoils which leave the emulsion. (Contractor's abstract)

2855

Virginia U. Research Labs. for the Engineering Sciences, Charlottesville.

IONIZATION YIELD OF LOW-ENERGY IONS IN ARGON, by J. A. Phipps, L. C. Towle, and R. A. Lowry. Oct. 1960, 15p. incl. diagrs. (Rept. no. EP-4419-105-60U) (AFOSR-TN-60-1241) (AF 49(638)22) AD 247075 Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 15, Jan. 27, 1960.

A cylindrical ionization chamber with a differentially pumped open window has been used to measure the total ionization yield of low energy heavy ions stopped in a gas. The ionization yield of protons in argon in the energy range of 25 to 250 kev was determined earlier. Recent results are presented on the ionization yield of argon and nitrogen ions in argon gas in the energy range of 25 to 100 kev. The average energy per ion pair for argon ions increases rapidly with decreasing energy in the above range and at 50 kev it is about three times the value for 200 kev protons. A comparison of the ionization yields in argon of various ions having velocities in the same region is presented. (Contractor's abstract)

2856

Vitro Corp. of America. Vitro Labs., West Orange, N. J.

DEVELOPMENT OF NONCONSUMABLE ANODE FOR FLUID TRANSPIRATION INTO A HIGH-INTENSITY ARC, by C. Sheer. Interim activities rept. Dec. 30, 1959 [19]p. incl. illus. diagrs. (AFOSR-3676) (AF 49(638)477) AD 617162 Unclassified

Details of the design of a nonconsumable anode are presented which feature the transpiration of a fluid medium through an anode having pores which are smaller in diameter than the anode sheath thickness. This nonconsumable anode meets the requirements of fully exploiting the energy present in the anode sheath by injecting the fluid into the sheath through the anode itself while at the same time preventing anode erosion. Experimental testing of this device has demonstrated that a plasma jet of various fluids can be generated while the arc is maintained at the high-intensity level of operation. Some of the characteristics of this type of plasma generator are described.

2857

Washington State U. Dept. of Chemistry, Pullman.

PYROLYSIS OF ESTERS, by G. G. Smith. Dec. 23, 1959 [11]p. incl. illus. diagrs. (AFOSR-TN-60-20) (AF 49(638)616) Unclassified

Progress is reported of an investigation on the thermal stability of organic and inorganic esters and closely related compounds. The object of the study has been to relate the stability (to heat) of these substances with their chemical formulas. Apparatus has been designed and constructed for use in the pyrolysis study, including a gas-liquid chromatograph.

2858

Washington State U. [Dept. of Chemistry] Pullman.

INTRODUCTION TO TABLES ON PYROLYSIS OF ESTERS. PYROLYSIS OF CARBOXYLATES, by G. G. Smith and F. D. Bagley. June 1960, 86p. incl. tables, refs. (AFOSR-TN-60-590) (AF 49(638)616) AD 238726; PB 161866 Unclassified

This is the first table of a series summarizing the temperatures, yields and references for the pyrolysis of esters of organic and inorganic acids and closely related nitrogen and sulfur analogues. Only esters which contain a β-hydrogen on the alkyl group and could possibly pyrolyze to olefins are included. Some of the included esters, however, e.g. unsaturated esters, do not pyrolyze to give olefin, but produce other substances such as rearranged products. Table I is concerned with pyrolysis of carboxylates and is organized first by number of carbons in the chain, secondly, by carbons in the alkyl portion of the ester and finally by dividing the substituted tertiary alcohol esters into polyhydric alcohol esters and enol alkanoates.

2859

Washington State U. Dept. of Chemistry, Pullman.

EFFECTS OF STRUCTURE ON THE PYROLYSIS OF ESTERS. PYROLYSIS OF ARYL AND BENZYL CARBONATES. III, by G. G. Smith and B. Kösters. [1960] 10p. incl. diagrs. tables, refs. (AFOSR-TN-60-655) (AF 49(638)616) AD 254809 Unclassified

Also published in Chem. Berichte, v. 93: 2400-2404, 1960.

Pyrolysis studies of substituted benzyl and aryl carbonates were made to determine the effect of electron releasing substituents on the elimination of ethylene. It is quite generally accepted that esters (including carbonates) pyrolyze by a quasi-six-membered ring intermediate involving the carbonyl oxygen of the acyl portion and the β-hydrogen of the alkyl moiety of the ester. In keeping with this theory the chloro-substituted aryl ethyl carbonates were more stable than the methoxy substituted or unsubstituted esters. o-Methoxybenzyl ethyl carbonate was surprisingly unstable. A neighboring group effect is proposed to explain the unexpected result. The aryl ethyl carbonates were all pyrolyzed at 500°. However, the substituted benzyl ethyl carbonates were essentially stable at this temperature and hence were studied at 525°; the pyrolysis time was 1 sec.

2860

Washington State U. Dept. of Chemistry, Pullman.

KINETIC STUDY OF THE PYROLYSIS OF 1, 2-DIARYLETHYL ACETATES. IV, by G. G. Smith, F. D. Bagley, and R. Taylor. [1960] [7]p. incl. diagrs. tables, refs. (AFOSR-65) (AF 49(638)616) Unclassified

Presented at 138th Nat'l. meeting of the Amer. Chem. Soc., New York, Sept. 1960.

Also published in Jour. Amer. Chem. Soc., v. 83: 3647-3653, Sept. 5, 1961.

A kinetic study of the thermal decomposition of 11 meta and para substituted 1, 2-diphenylethyl acetates has been made. The energies and entropies of activation range from 40.6 to 43.8 kcal/mol and -0.215 to -2.54 eu, respectively. The esters (both solids and liquids) were each pyrolyzed over a temperature range of 50° in a static system at reactant pressure of 15 to 150 mm by use of a specially designed apparatus. The importance of the breaking of the carbon-hydrogen and carbon-oxygen single bonds and the formation of olefinic bond to the stability of the ester has been evaluated. Esters with strongly electron-releasing groups (e.g., 4-OCH_3) in the 1-phenyl ring were very sensitive to surface reactions and could only be studied satisfactorily in the presence of an inhibitor. (Contractor's abstract)

2861

Washington State U. Dept. of Chemistry, Pullman.

CONVENIENT REACTOR FOR STUDYING REACTION KINETICS OF HIGH BOILING LIQUIDS IN THE GAS PHASE, by G. G. Smith and F. D. Bagley. [1960] [3]p. incl. illus. diagrs. table. (AFOSR-455) [AF 49-(638)616] AD 262596 Unclassified

Also published in Rev. Scient. Instr., v. 32: 703-705, June 1961.

A new reactor has been built for studying reaction kinetics of high boiling liquids in the gas phase, which provides a means of rapid, easy introduction of the reactant and careful monitoring of pressure changes. Reaction rates were determined for the pyrolysis of 1, 2-diarylethyl acetates. (Contractor's abstract)

2862

Washington State U. Dept. of Psychology, Pullman.

STUDIES OF SHORT TERM RETENTION: I. RECALL OF UNRELATED ITEMS IN A SEQUENTIAL TASK, by

K. E. Lloyd. June 1960, 12p. incl. diagrs. tables. (Research rept. no. WSU-1) (AFOSR-TN-60-1057) (AF 49(638)805) AD 247385; PB 153403
Unclassified

Short term retention was studied in a situation requiring subjects to remember familiar letter-word pairs until their recall was requested. During the time the subjects were required to remember these items they were presented other items or asked to recall previously presented items. A measure of the average number of items being remembered at the time of a requested recall was investigated as an independent variable. Subjects listened to tape recorded sequences of the letter-word pairs. When they heard a letter alone they were instructed to recall all words previously paired with that letter. The average number of letter-word pairs that the subjects were required to remember varied from 2.5 to 12.5. Recall errors were found to increase systematically with an increase in the average number of items the subjects were remembering. These results show high agreement with previous studies of short term retention in this sequential task. The independent variable, termed average storage load, has now been shown to be related to recall errors over a wide range of its values, for related and unrelated items, and under conditions where subjects recall one or several items at each recall point. Average storage load may provide a means of scoring, or ordering, operational tasks that require storage of information for short periods of time. (Contractor's abstract)

2863

Washington State U. Dept. of Psychology, Pullman.

STUDIES OF SHORT TERM RETENTION: III. RECALL AS A FUNCTION OF VERBAL CONTEXT, by W. A. Johnston and K. E. Lloyd. Dec. 1960, 13p. (Research rept. no. WSU-3) (AFOSR-73) (AF 49(638)805) AD 254810; PB 155813 Unclassified

The 3 variables examined in the present study were verbal contex, word order (response order and stimulus order), and average storage load. It was hypothesized that the relationship between verbal context and correct recall would be negative in the stimulus order condition and positive in the response order condition. When verbal context was high, performance was expected to differ significantly between the stimulus order and response order conditions. Furthermore, recall was expected to vary directly with average storage load. Word passages which varied in order of approximation to the English sentence (zero, second, fourth, and eighth orders) were obtained for this study. Verbal context increased as the passages varied from the zero to the eighth order. Eight sequences of items (letter-word pairs) and recall points (letters alone) were prepared for each of the 2 word order conditions. Each sequence was subdivided into 8 subsequences. A subsequence was composed of 20 items and 10 recall points. The subsequences varied with respect to verbal context and average storage load (3.0 and 7.0 words). Twelve subjects responded to sequences in the stimulus order condition, and 12 subjects responded to sequences in the response order condition. Each subject participated 45 min a day for 4 successive days. The results indicated that verbal context was positively related to recall in the response order group but had no influence on performance in the stimulus order group. The 2 groups differed significantly at the fourth and eighth orders of approximation. The greatest share of recall variation was due to variation in average storage load.

2864

Washington State U. Dept. of Psychology, Pullman.

STUDIES OF SHORT TERM RETENTION: II. RECALL AS A FUNCTION OF ITEM FREQUENCY, by K. E. Lloyd and W. A. Johnston. Dec. 1960, 11p. incl. diagrs. tables. (Research rept. no. WSU-2) (AFOSR-299) (AF 49(638)805) AD 254811; PB 155812
Unclassified

Short term retention was studied in a situation requiring subjects to remember familiar letter-word pairs until their recall was requested. During the time the subjects were required to remember these items they were presented other items or asked to recall previously presented items. The major independent variable investigated was the frequency of occurrence of the items that were presented to the subjects. A second independent variable was the average number of items being remembered at the time of a requested recall. The average number of letter-word pairs that the subjects were required to remember was 3.5 and 6.5. Recall errors were found to decrease with an increase in the range of item frequency variation, and to increase with an increase in the average number of items the subjects were remembering. An examination of percent recall scores for the items which occurred with different frequencies indicated that the improvement in recall for the high range group was partly due to greater recall of high frequency items and partly due to greater recall of low frequency items. That is, the high range group tended to exceed the low range group at all frequency values. (Contractor's abstract)

2865

Washington U. [Dept. of Mathematics] St. Louis, Mo.

HANKEL MULTIPLIER TRANSFORMATIONS AND WEIGHTED p-NORMS, by D. L. Guy. [1955] [53]p. incl. refs. [AF 49(638)218] Unclassified

Presented at meeting of the Amer. Math. Soc., Nov. 25, 1955 and Dec. 29, 1955. (Title varies).

Published in Trans. Amer. Math. Soc., v. 95: 137-189, Apr. 1960.

The Hankel multiplier transformations in L^p spaces, where $1 < p \leq 2$, is analyzed. There is established for these transformations a close analogue of a theorem of J. Marcinkiewicz on a criterion for the existence of bounds for L^p Fourier series multiplier series.

2866

Washington U. Dept. of Mathematics, St. Louis, Mo.

MULTIPLIER TRANSFORMATIONS. II, by I. I. Hirschman, Jr. Apr. 1960, 15p. (AFOSR-TN-60-31) (AF 49(638)218) AD 235948 Unclassified

Also published in Duke Math. Jour., v. 28: 45-56, Mar. 1961.

Several topics are discussed relative to multiplier transformations on spaces of functions over n dimensional Euclidean space defined by weighted quadratic norms with positive definite weight functions. Beurling (Analysis in some convolution Algebras, Symposium on Harmonic Analysis and Related Integral Transforms, Cornell 1956) has shown that the class of multiplier functions on a space is preserved by operations of Lipschitz class 1. An investigation is made of operations of Lipschitz class ρ. These are found to carry multiplier functions on another space with a proportionately weaker norm. Attention is restricted to multipliers determined by functions homogeneous of degree 0. These are the Calderon-Zygmund multipliers. Parallel results for p-norms are established for weighted quadratic norms. Riesz-Bochner summability is treated. This corresponds to the case in which the multiplier function is spherically symmetric. (Contractor's abstract)

2867

Washington U. Dept. of Mathematics, St. Louis, Mo.

ROOTS OF INNER AUTOMORPHISMS, by F. Haimo. Apr. 1960, 11p. (AFOSR-TN-60-32) (AF 49(638)218) AD 235985 Unclassified

The problem of finding a group with an outer automorphism α with n-th power inner and n^2-power trivial, proposed by M. Auslander, is studied. The fixed points of α lie in the center of the group. The direct sum $H \oplus (H/H^1)$ formed with a group H is reduced by a suitable subgroup. The quotient group has a normal automorphism with a power which is inner. H as of class 2 and the group of three-by-three triangular matrices over some commutative ring R with a unity are developed. A choice of R provides a variety of cases related to that of Auslander. Under mild restrictions, the fixed points of the α^m are the same once α is chosen.

2868

Washington U. Dept. of Mathematics, St. Louis, Mo.

THE COHOMOLOGY THEORY OF A PAIR OF GROUPS, by F. Haimo and S. MacLane. Apr. 1960, 24p. incl. refs. (AFOSR-TN-60-115) (In cooperation with Chicago U. Dept. of Mathematics, Ill.) (AF 18(600)-1383 and AF 49(638)218) AD 235987; PB 146781 Unclassified

Also published in Illinois Jour. Math., v. 5: 45-60, Mar. 1961.

A cohomology theory is developed for a pair of groups B and C with coefficients in an abelian group A. The new bicohomology of the pair B, C is related to the cohomology of the sum of B and C. By using standard resolutions and tensor products of such resolutions, an explicit relation is established between the bicohomology groups of the pair B, C and the cohomology groups of the sum of B and C. Some pairs of extensions of A by B, C (the coherent pairs, those which can be included in a further common extension by C, B respectively) can be put into faithful correspondence, not with the 2-bicohomology group H^2, but with an epimorphic image T thereof, where the kernel involves splitting extensions. Let F, G be a coherent pair of extensions of A by B, C. Then the group of autoequivalences of G_1 over A can be extended by B, C to a pair which corresponds to the pair F, G under a homomorphism between the appropriate T-groups. Reduction theorems, (the cup-product one, for example) are obtained as in the classical case. At lowest dimension, it is T, not H^2, which is more readily reduced. (Contractor's abstract)

2869

Washington U. Dept. of Mathematics, St. Louis, Mo.

VARIATION DIMINISHING HANKEL TRANSFORMS, by I. I. Hirschman, Jr. Apr. 1960, 38p. incl. diagrs. refs. (AFOSR-TN-60-358) (AF 49(638)218) AD 235988; PB 146782 Unclassified

Also published in Jour. Anal. Math. (Jerusalem), v. 8: 307-336, 1960/1961.

Let L^p denote the set of real measurable functions $f(x)$ defined for $0 < x < \infty$. A function $G(x) \in L^p(-\infty, \infty)$, for $p = 1$, is said to be a variation diminishing o-kernel if $V[G \circ \Phi] \leq V[\Phi]$ for every continuous function $\Phi(x)$ defined on $(-\infty, \infty)$. $V[\Phi]$ is the number of changes of sign of $\Phi(x)$ on the interval. An analogous theory associated with certain convolutions defined for functions on $(0, \infty)$ is established. The operation T is shown to have most of the familiar properties of the convolution operation o on the real line. The Hankel transform of $f(x)$ is defined as $\int J(xt) f(x)\, dM(x)$ for $0 \leq t < \infty$. The principal result is that H is a variation diminishing T-kernel if and only if (after multiplication by a suitable constant) the Hankel transform is equal to $\int H(x) J(xt)\, dM(x)$ for $0 \leq t < \infty$.

2870

Washington U. Dept. of Mathematics, St. Louis, Mo.

MEAN SUMMABILITY FOR ULTRASPHERICAL POLYNOMIALS, by R. Askey and I. I. Hirschman, Jr. Apr. 1960, 18p. incl. refs. (AFOSR-TN-60-396) (AF 49-(638)218) AD 235989 Unclassified

The results of this paper apply to ultraspherical polynomials; however, for notational simplicity the treatment

is confined to the special case of Legendre polynomials. Let $P_n(x)$, $n = 0, \ldots$, be the Legendre polynomials normalized in the usual fashion. For $f(x) \in L^1(-1, 1)$ is set $\hat{f}(n) = \int_{-1}^{1} f(x) P_n(x)dx$. The formal development of $f(x)$ as a series of Legendre polynomials is then $\sum_{n=0}^{\infty} (n + 1/2)\hat{f}(n)P_n(x)$. Let $f(x) \in L^p(-1,1)$. Pollard has proved that if $4/3 < p < 4$ the series of partial sums converges in the mean of order p to $f(x)$. In this study it is shown that the Cesaro sums of order α converge in the mean of order p to $f(x)$ if $0 \le \alpha < 1/2$ and if $4/(3 + 2\alpha) < p < 4/(1 - 2\alpha)$. The conclusion is false if $p < 4/(3 + 2\alpha)$ or $p > 4/(1 - 2\alpha)$. The case $\alpha = 0$ is Pollard's theorem. (Contractor's abstract)

2871

Washington U. Dept. of Mathematics, St. Louis, Mo.

VARIATION DIMINISHING TRANSFORMATIONS AND ORTHOGONAL POLYNOMIALS, by I. I. Hirschman, [Jr.]. June 1960, 23p. incl. refs. (AFOSR-TN-60-640) (AF 49(638)218) AD 244260 Unclassified

Also published in Jour. d'Analyse Math., v. 8: 337-360, 1960/1961. (Title varies)

Let $P^{(\alpha, \beta)}(x)$ be the Jacobi polynomials in the usual normalization. Put $h_{\alpha, \beta}(n) = \frac{2\alpha+\beta+1 \Gamma(n + \alpha + 1)\Gamma(n + \beta + 1)}{(2n + \alpha + \beta + 1)n!\ \Gamma(n + \alpha + \beta + 1)}$, and $\Omega_{\alpha, \beta}(x) = (1 - x)^{\alpha}(1 + x)^{\beta}$. Let $l^2_{\alpha, \beta}$ consist of those real functions $f(n)$ defined for $n = 0, 1, 2, \ldots$ for which $\|f\|_2 = [\Sigma_{n=0}^{\infty} |f(n)|^2 h_{\alpha, \beta}(n)]^{1/2} < \infty$. For $f \in l^2_{\alpha, \beta}$ $T_M f(n) = [h_{\alpha, \beta}(n)]^{-1} \int_{-1}^{1} \hat{f}(x)P_n^{(\alpha, \beta)}(x)M(x)\Omega_{\alpha, \beta}(x)\, dx$, is defined where $M(x)$ is a real, bounded, measurable function defined on $[-1, 1]$ and $\hat{f}(x) = \Sigma_{n=0}^{\infty} f(n)P_n^{(\alpha, \beta)}(x)$. Transformations of the form T_M (which are bounded transformations of $l^2_{\alpha, \beta}$ into itself) are called multiplier transformations in $l^2_{\alpha, \beta}$. Let $V[f]$ be the number of changes of sign of $f(n)$ for $n = 0, 1, 2, \cdots$. $M(x)$ will be called variation diminishing multiplier if, for every $f \in l^2_{\alpha, \beta}$: $V[T_M f] \le V[f]$. In the present paper it is shown that $M(x)$ is variation diminishing in $l^2_{\alpha, \beta}$ if and only if it is of the form $M(x) = de^{cx} \prod_{k=1}^{\infty} (1 + a_k x)/\prod_{k=1}^{\infty} (1 - b_k x)$, where $c \ge 0$, $1 \ge a_k \ge 0$, $1 > b_k \ge 0$ and $\Sigma(a_k + b_k) < +\infty$. (Math. Rev. abstract)

2872

Washington U. Dept. of Mathematics, St. Louis, Mo.

ON REAL CHARACTERS OF CERTAIN SEMI-GROUPS WITH APPLICATIONS, by A. Devinatz and A. E. Nussbaum. June 1960, 27p. incl. refs. (AFOSR-TN-60-642) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)218 and National Science Foundation under NSF-G10715) AD 245119; PB 152747 Unclassified

Also published in Duke Math. Jour., v. 28: 221-237, June 1961.

An open semi-group is an open subset S of a topological group G (which is not assumed to be locally compact or abelian), which is a semi-group with respect to multiplication defined in G. Every homomorphism of an open semi-group into the multiplicative semi-group of real numbers which is positive and bounded in an open set of S is shown to be continuous. This result is applied to a semi-group $\{T_x; x \in S\}$ of bounded self-adjoint operators T_x on a Hilbert space, and an integral representation of such a semi-group of operators is obtained. Proof is given that if the open semi-group S has the identity e of G as a contact point, G is locally compact and a semi-group $\{T_x; x \in S\}$ of bounded self-adjoint operators is weakly measurable with respect to the measure induced on S by the Haar measure of G, then $\{T_x\}$ is strongly continuous. The integral representation of the semi-group of operators is applied to completely monotonic functions on an open semi-group and an integral representation of such functions is obtained.

2873

Washington U. Dept. of Physics, St. Louis, Mo.

[PHYSICAL ELECTRONICS] by R. N. Varney. Final rept. Nov. 1, 1954 - Oct. 1, 1960, 9p. incl. refs. (AFOSR-501) (AF 18(600)1317) Unclassified

Research was conducted on collisions of ions with atoms and molecules over a wide range of collision energies as well as molecular types. There were 3 main tests: (1) swarm experiments in which ions drifted through gases having elastic, inelastic, and associative and dissociative collisions in the process; (2) mass spectrographic analysis of the ions produced by collisions with gas atoms and molecules; and (3) direct studies in which single collisions occur between ions and gas atoms and both the number of ionizing events and the character of the ejected electrons can be analyzed. The 1st two experiments were characterized by highly successful theoretical analyses. Four secondary experiments were also done: (1) the secondary emission of electrons under electron bombardment of magnesium; (2) the chemical reactivity of the various types of nitrogen ions; (3) the secondary emission of electrons by bombardment of surfaces by neutral mercury atoms; and (4) the diffusion of electrons emitted into a gas from a cathode surface. (See also item nos. WAS. 05:001-002, Vol. I;WAS. 05:003-005, Vol. II; 2173, Vol. III; and 2874, Vol. IV)

2874

Washington U. Dept. of Physics, St. Louis, Mo.

STATISTICAL MECHANICS OF MOLECULAR IONS, by R. N. Varney. [1960] [3]p. incl. diagr. table. [AF 18(600)1317] Unclassified

Published in Jour. Chem. Phys., v. 33: 1709-1711, Dec. 1960.

The N_4^+ ion is shown to be able to be in equilibrium against dissociation into N_2^+ and N_2 under specified experimental conditions only if it possesses a considerable degree of vibrational excitation. The A_2^+ ion, lacking the numbers of modes of vibrational freedom possessed by the N_4^+, is therefore unstable under the same conditions. It becomes stable in much weaker electric fields and simultaneously higher pressures. Experimental evidence is advanced that it is metastable and subject to dissociation with sufficient numbers of collisions in the gas. (Contractor's abstract)

2875

Washington U. Dept. of Physics, St. Louis, Mo.

A TABLE OF CIRCULARLY POLARISED GAMMA RAY COMPTON SCATTERING CROSS SECTIONS, by D. A. L. Paul. Feb. 1960, 38p. incl. tables. (Technical rept. no. 28) (AFOSR-TN-60-153) (AF 18(603)108) AD 234098 Unclassified

Tables of Compton scattering cross sections are given for gamma rays from 0.25 kev to 10 mev, and for all scattering angles by increments of cos 0.05. Both circular polarization dependent and circular polarization independent cross sections are given, and also the ratio of these cross sections. In computing polarization dependent cross sections, the spin orientation of the scattering electron was chosen to make the cross section a maximum. The spin orientation required to do this is also tabulated. (Contractor's abstract)

2876

Washington U. Dept. of Physics, St. Louis, Mo.

THE APPROACH TO EQUILIBRIUM IN QUANTAL SYSTEMS: MAGNETIC RESONANCE, by A. Sher and H. Primakoff. Jan. 1960, 115p. incl. refs. (Technical rept. no. 28) (AFOSR-TN-60-154) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)108 and Office of Ordnance Research) AD 234019 Unclassified

Also published in Phys. Rev., v. 119: 178-207, July 1, 1960.

A derivation is presented of the "master" or Boltzmann "gain-loss" equation from the Schrödinger equation, i.e., a derivation of the equation for the evolution in time of the probabilities of finding a physical system in its various states from the equation for the corresponding probability amplitudes. The "master" equation is derived for a "super-system" [A + B], consisting of a "system of interest," [A], and a "surroundings," [B], in relatively weak mutual interaction. A discussion is given of the range of validity of the "master" equation for [A + B], and the random phase assumption is shown to be required for the state vector of [A + B] at the initial time only. The normally microcanonical character of the equilibrium statistical configuration of [A + B] is demonstrated and a treatment is given of exceptional, "extremely quantal-coherent," initial statistical distributions of [A + B] which may evolve away from equilibrium. Derivations are also presented of the "master" equation for [A] and for an individual particle or quasi-particle [q], within [A]. A discussion of the range of validity of these "master" equations is given. The normally canonical character of the equilibrium statistical configuration of [A] is deduced. Solutions of the "master" equations for [A + B], [A], and [q] are solved. The relation between the principles of "microscopic reversibility," "detailed balance," and the nonoscillatory character of the approach to equilibrium are exhibited. A theorem is presented regarding the time variation of the entropy of [A].

2877

Washington U. [Dept. of Physics] St. Louis, Mo.

EFFECTIVE SPIN-ORBIT POTENTIAL IN CORRELATED HEAVY NUCLEI, by J. W. Clark. Feb. 1961 [18]p. incl. refs. (Technical rept. no. 38) (AFOSR-TN-60-453) (AF 18(603)108) AD 257507 Unclassified

Also published in Ann. Phys., v. 11: 483-500, Dec. 1960.

A many-body system is considered. A particle N in the system moves under the influence of the remaining N-1 particles, taken to be nucleons, and every total particle-particle interaction contains a repulsive core. An expression is derived for that part of the effective 1-body potential felt by particle N which is due to a specific portion v_{iN} of its interaction with each of the nucleons $i = 1, \ldots, N-1$, on the basis of a system wave function of the Jastrow type, neglecting exchange contributions involving particle N. This result is used to estimate the spin-orbit splittings in the region of Pb^{208} generated by the Gammel-Thaler and Signell-Zinn-Marshak 2-body spin-orbit potentials. In both cases the theoretical splittings are of the correct sign and about the right magnitude to explain the observed doublet separations. (Contractor's abstract)

2878

Washington U. Dept. of Physics, St. Louis, Mo.

UPPER LIMIT FOR THE INTRINSIC ELECTRIC DIPOLE MOMENT OF THE PROTON AND THE NEUTRINO, by S. Rosendorff. Feb. 1961 [8]p. incl. refs. (Technical rept. no. 35) (AFOSR-TN-60-454) (AF 18-(603)108) AD 257507 Unclassified

Also published in Nuovo Cimento, Series X, v. 17: 251-258, July 16, 1960.

The elastic scattering of electrons by a proton with an intrinsic electric dipole moment (edm) is calculated in first Born approximation. The cross section is quite sensitive to the edm interaction at high energies and large angles. It therefore seems likely that high energy electron-proton scattering may give valuable information of the value or upper limit of the proton edm coupling strength. Certain spin correlation effects between the recoil proton and the initial electron arising from the edm interaction are also discussed. In the last section the calculation of the ionization power of a neutrino due to its intrinsic edm is briefly outlined and compared with the experimental results of Cowan and Reines. (Contractor's abstract)

2879

Washington U. Dept. of Physics, St. Louis, Mo.

PRODUCTS OF PRINCIPAL VALUE SINGULARITIES USED IN THE FORMAL THEORY OF SCATTERING, by S. Tani. [1960] [4]p. (Technical rept. no. 41) (AFOSR-TN-60-547) (AF 18(603)108) AD 260596 Unclassified

Also published in Jour. Math. Phys., v. 2: 198-201, Mar.-Apr. 1961.

A mathematically neat derivation is given of the relation between the S matrix and the transformation function for a finite time. It is shown that one can dispense with the adiabatic switching on and off, and yet one reaches the same result as when one employs it. Necessary conditions are discussed for the validity of this statement. Systematic prescriptions are given of handling products of principal value singularities, which is relevant to the scattering theory in momentum space. (Contractor's abstract)

2880

Washington U. Dept. of Physics, St. Louis, Mo.

STRUCTURE OF WEAK INTERACTIONS, by J. Dreitlein and H. Primakoff. Aug. 1960, 137p. incl. tables, refs. (Technical rept. no. 34) (AFOSR-TN-60-567) (AF 18(603)108) AD 241698 Unclassified

The general structure of weak dynamics is studied from an S-operator formalism with a minimum number of assumptions and the consequences of the formalism are applied to the study of the weak interactions of particles of strangeness zero - nucleons, muons, electrons, neutrinos and photons. In order to investigate the weak dynamics involved in nuclear beta decay, the possibility of a conserved nucleon current as the element coupled to the lepton current is discussed and the consequences of such a current are sought in the forbidden nuclear beta transitions. Next, the problem of muon decay from the Coulomb-bound lowest Bohr orbit is subjected to a theoretical analysis. Of particular concern are the μ-decay rate and the influence of a Coulomb field on a charged boson coupling the weak currents. Finally, the possibility of very weak interactions is entertained and 2 models of such interactions are investigated — the model of multiple weak interactions suggested by second order perturbation theory and a purely phenomenological model allowing the radiative conversion of muons to electrons. (Contractor's abstract)

2881

Washington U. [Dept. of Physics] St. Louis, Mo.

NEUTRON POLARIZATION IN THE REACTION $D(d,n)He^3$ AT E_d = 8.2 MEV, by W. Daehnick. [1959] [3]p. incl. diagrs. (Technical rept. no. 29) (AFOSR-TN-60-852) (AF 18(603)108) AD 247257 Unclassified

Also published in Phys. Rev., v. 115: 1008-1010, Aug. 15, 1959.

The polarization of neutrons from the reaction $D(d,n)He^3$ was measured at 8.2 mev incident deuteron energy. By the use of He^4 as a polarization analyzer and a triple coincidence technique systematical errors in the experiment were kept very small, but at a sacrifice in counting rate. Polarization measurements were made at center-of-mass angles of 0°, 47°, and 59°. The value obtained for the neutron polarization and their probable statistical errors are $P(0°) = (-)0.007 \pm 0.007$, $P(47°) = -0.097 \pm 0.060$, and $P(59°) = -0.101 \pm 0.060$. (Contractor's abstract)

2882

Washington U. Dept. of Physics, St. Louis, Mo.

STRUCTURE OF THE S MATRIX IN THE PRESENCE OF A BOUND STATE, by S. Tani. [1960] [4]p. incl. refs. (Technical rept. no. 39) (AFOSR-TN-60-964) (AF 18(603)108) AD 260596 Unclassified

Also published in Phys. Rev., v. 121: 346-349, Jan. 1, 1961.

It is shown that the phase factor associated with the "orthogonality phase shift" due to a bound state should be factored out of the S matrix. A crucial test of this statement is found in a study of the final state interaction of an inelastic process which ends in a channel involving the bound state. If we assume that the sum of the Born series for the S matrix gives a right answer after we separate the effect of the bound state in terms of the orthogonality phase shift, an agreement with Watson's result obtains only when the S matrix has the factored structure. (Contractor's abstract)

2883

Washington U. Dept. of Physics, St. Louis, Mo.

THE HEAVY COMPONENT OF THE PRIMARY COSMIC RADIATION DURING SOLAR MAXIMUM, by C. E. Fichtel. [1960] [16]p. incl. diagrs. tables, refs.

(Technical rept. no. 45) (AFOSR-TN-60-1388) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)108, National Science Foundation, and Office of Ordnance Research) AD 260596
Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 258, Apr. 25, 1960.

Also published in Nuovo Cimento, Series X, v. 19: 1100-1115, Mar. 16, 1961.

The heavy component of the primary cosmic radiation was studied at geomagnetic latitude 55° N at a time of solar maximum. The total flux was found to be down by a factor of about two, compared to the results obtained during solar minimum, but the change spectrum was found to be the same to within experimental errors. The extrapolated fluxes at the top of the atmosphere were found to be: (3.08 ± 0.64) particles/m^2 ster sec for $3 \leq Z \leq 5$; (8.25 ± 0.82) particles/m^2 ster sec for $6 \leq Z \leq 9$; and (2.96 ± 0.49) particles/m^2 ster sec for $10 \leq Z$. When this work was combined with that of other experimentalists obtained at different latitudes and compared to the data obtained at solar minimum, the change in the integral spectrum was found to be in fair agreement with the predictions of an electric deceleration modulating mechanism. (Contractor's abstract)

2884

Washington U. Dept. of Physics, St. Louis, Mo.

PRIMARY COSMIC RAY α-PARTICLES, I, by C. [E.] Fichtel and M. W. Friedlander. [1960] [20]p. incl. diagrs. table, refs. (Technical rept. no. 44) (AFOSR-TN-60-1389) (In cooperation with Rochester U., N. Y. AF 49(638)303) (AF 18(603)108) AD 260596
Unclassified

Also published in Nuovo Cimento, Series X, v. 19: 1090-1099, Mar. 16, 1961.

See Rochester U., item no. 2405, Vol. IV.

2885

Washington U. Dept. of Physics, St. Louis, Mo.

THE MEAN FREE PATH FOR α-PARTICLES IN NUCLEAR PHOTOGRAPHIC EMULSION, by R. L. English. [1960] [1]p. incl. table. (Technical rept. no. 46) (AFOSR-TN-60-1390) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)-108, National Science Foundation, and Office of Ordnance Research) AD 260596 Unclassified

Also published in Nuovo Cimento, Series X, v. 19: 1269, Mar. 16, 1961.

The experimental values of the α-particle mean free path in nuclear emulsion with kinetic energies of values between 90 mev/nucleon and several gev/nucleon were observed. The results are as follows:

	Track length (cm)	No. of Interactions	M. F. P. (cm)
E > 600 mev/nucleon	1378.0	75	18.4
E ≤ 600 mev/nucleon	1044.4	49	21.3
All particles	2422.4	124	19.6

Combining this data with that obtained by Lohrmann, Teucher and Mulvey the best estimated of λ is $\lambda = (19.2 \pm 0.4)$cm.

2886

Washington U. Dept. of Physics, St. Louis, Mo.

GROUND STATE OF LIQUID HELIUM (MASS 4), by F. Y. Wu and E. Feenberg. [1960] [4]p. incl. diagrs. tables. (Technical rept. no. 42) (AFOSR-4) (AF 18-(603)108) AD 260596 Unclassified

Also published in Phys. Rev., v. 122: 739-742, May 1, 1961.

The wave function describing the ground state of a boson system is approximated by the function $\Psi = \Pi \exp[1/2\, u(r_{ij})]$. The superposition approximation is then used to derive a linear, inhomogeneous integral equation for du/dr in which the only other quantities occurring are the experimentally observed two-particle distribution function g(r) and its first derivative. A numerical solution for He^4 is computed and compared with the explicit approximate solution derived by Abe. Using the computed u(r) and a proper smooth extrapolation of g(r) into the region below the apparent cutoff at r = 2.34A, the kinetic energy of liquid He^4 at absolute zero is estimated at 2.91×10^{-15} ergs/atom. A functional J(du/dr) is constructed with the property that Abe's integral equation for du/dr is just the Euler equation associated with the problem of finding a u for which J takes on an extreme value. The extreme value of J (actually a maximum) is simply related to the expectation value of the kinetic energy. The variational property is used to determine the best u(r) from a family of trial functions. The calculated value of the kinetic energy and the measured total energy are used, in conjunction with the virial theorem, to determine the coefficients of a 6-n Lennard-Jones potential. At n = 12, the calculation yields a deeper potential well and a slightly wider repulsive region than is calculated from the properties of the gas phase. (Contractor's abstract)

2887

Washington U. [Dept. of Physics] St. Louis, Mo.

DIVERGENCE-FREE ITERATIVE EXPANSION OF THE S MATRIX IN A FIELD THEORY, by K. Haller. [1960] [13]p. incl. diagr. table, refs. (Technical rept. no. 37) (AFOSR-95) (AF 18(603)108) AD 255823
Unclassified

Published in Phys. Rev., v. 120: 1045-1057, Nov. 1, 1960.

A new method is proposed for evaluating the S- matrix as a series expansion in powers of the coupling constant. The method is applicable to field theories which in the usual formulation have ultraviolet divergences in self-energy and vertex parts and require self-energy, coupling constant, and wave-function renormalization. The procedure cannot be applied in its present form to theories which allow boson self-energy terms. In this new procedure the usual form of the Hamiltonian for the coupled system is retained. The theory results in an iterated solution in powers of the physical coupling constant and yields a series, each term of which is finite without subtractions or renormalization. It agrees up to all orders examined with the finite S-matrix elements obtained by renormalizing the old formulation of the scattering problem. It is also shown that the nth order contribution to the iterative expansion of the S matrix, where n is any order, approaches 0 more rapidly, at high energy, than $E^{-(2-\delta)}$ where δ is any positive real number, no matter how small. (Contractor's abstract)

2888

Washington U. Dept. of Physics, St. Louis, Mo.

SYNTHETIC APPROACH AND CANONICAL VARIABLES IN A NONLOCAL FIELD THEORY, by S. Tani. [1960] [6]p. incl. refs. (AFOSR-406) (AF 18(603)108) AD 260596 Unclassified

Also published in Jour. Math. Phys., v. 2: 46-51, Jan.-Feb. 1961.

The analysis of the axiomatic structure of quantum field theory establishes the synthetic approach. The translation in time is completely defined by its transformation function; it defines also canonical variables. The Hamiltonian is discussed to establish the correspondence between this approach and the conventional one. An application is made to analyze Kristensen-Møller's theory of a nonlocal field. Its field variables are shown to be noncanonical; 2 field operators referring to 2 different points at the same time are not independent from each other, when the distance between the 2 points is of the order of the extension of the form factor. However, this fact does not disturb the calculation of the S matrix. The situation is clearly understood when the Kristensen-Møller field operators are compared with the corresponding canonical variables. (Contractor's abstract)

2889

Washington U. Dept. of Physics, St. Louis, Mo.

ELECTRON SPIN RELAXATION IN METAL-AMMONIA SOLUTIONS, by V. L. Pollak. [1960] [9]p. incl. illus. diagrs. refs. (Technical rept. no. 39 under AF 49(638)464 and Technical rept. no. 47 under AF 18-(603)108) (AFOSR-584) (AF 18(603)108 and AF 49-(638)464) AD 260596 Unclassified

Also published in Jour. Chem. Phys., v. 34: 864-872, Mar. 1961.

The pulsed magnetic resonance technique was employed to measure the electron spin relaxation times T_1 and T_2 in solutions of sodium and potassium in liquid ammonia. Measurements were carried out over a range of temperatures from -50°C to +30°C, and for the concentration range of 10^{-4} to 10^{-2} mole metal per mole NH_3. It was found that T_1 and T_2 are equal at all measured concentrations and temperatures, these times ranging from 1 to 3 μsec. For dilute solutions, the data are shown to be quantitatively consistent with the assumption that the relaxation is owing to the contact hyperfine interaction of the electrons with the N^{14} nuclei of ammonia. This interaction is modulated by the relative motion of the electrons and the ammonia molecules, the spin relaxation time being proportional to the modulation rate, as is typical in cases of extreme motional narrowing. An electron tunneling mechanism is proposed as a possible source of the modulation. That the electron-nitrogen hyperfine interaction is largely responsible for the spin relaxation in dilute solutions is verified by measurements on a sample prepared from isotopically substituted ammonia ($N^{15}H_3$). A qualitative explanation of the variation of the electron spin relaxation time with concentration is proposed. (Contractor's abstract)

2890

Washington U. [Dept. of Physics] St. Louis, Mo.

LONGITUDINAL POLARIZATION OF ELECTRONS FROM Pr^{144} (Abstract), by W. A. Mehlhop, E. D. Lambe, and T. A. Pond. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)108], National Science Foundation, and Research Corp.) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 9, Jan. 27, 1960.

A Møller scattering apparatus has been used for a precision comparison of the longitudinal polarizations of the Pr^{144} (2.98 mev) and Y^{90} (2.24 mev) beta particles with kinetic energies greater than 0.95 mev. The scatterer was 2.56 mg/cm^2 Deltamax magnetized to about 14,500 G. Asymmetries under reversal of the magnetization, arising from geometric and electronic misalignments, were carefully studied and shown to be very small. Scatterings from chamber walls, and multiple scattering and depolarization in source and scatterer all resulted in small corrections: the ratio of Møller asymmetry under reversal of the magnetization for Pr^{144} to that for Y^{90} was shifted from 0.97 ± 0.026 (raw datum) to 0.986 ± 0.030 (corrected final value). The equality (within error) of these polarizations allows an upper limit to be set on the pseudoscalar interaction present

in Pr^{144}. The limit set here is in agreement with that obtained from precision Pr^{144} spectrum-shaped studies.

2891

Washington U. [Dept. of Physics] St. Louis, Mo.

INCOHERENT SCATTERING OF 0.662-MEV GAMMA RAYS (Abstract), by J. V. Jovanovich and J. P. Hurley. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)108] and National Science Foundation) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 68, Jan. 27, 1960.

An intense collimated beam of 0.662-mev gamma rays produced by a 130 curie Cs^{137} source was used to measure the scattering from thin targets of pure gold, silver, and copper. The scattered radiation was measured simultaneously at four different angles, 60°, 90°, 120°, and 150°. The experimental results will be compared with the existing theoretical cross sections for incoherent and coherent scattering.

2892

Washington U. [Dept. of Physics] St. Louis, Mo.

PROTON HYPERFINE SPECTRA OF DIPHENYL PICRYL HYDRAZYL, by Y. DeGuchi. [1960] [1]p. incl. diagr. refs. (Technical rept. no. 31) (AFOSR-TN-60-122) (AF 49(638)464) AD 257508 Unclassified

Also published in Jour. Chem. Phys., v. 32: 1584-1585, May 1960.

The electron spin resonance spectra is observed for diphenyl picryl hydrazyl, DPPH, in purified tetrahydrofuran in which the concentration of DPPH is less than 10^{-3} mol/l. Proton hyperfine lines are seen throughout the spectrum, those at the low-field side appearing sharper than those at the high-field side probably due to the anisotropic effect of the DPPH molecule. This spectrum is also obtained for other solvents, i.e., diethyl ether, 1,2-dimethoxyethane, cyclohexane, and carbon disulfide when purified by the process of Lewis et al. (Jour. Amer. Chem. Soc., v. 66: 1579-1583, 1944).

2893

Washington U. [Dept. of Physics] St. Louis, Mo.

SPIN EXCHANGE IN BIRADICALS, by D. C. Reitz and S. I. Weissman. [1960] [5]p. incl. diagrs. (Technical rept. no. 33) (AFOSR-TN-60-218) (AF 49-(638)464) AD 257508 Unclassified

Also published in Jour. Chem. Phys., v. 33: 700-704, Sept. 1960.

The electron spin resonance spectra of 4 isotopically labeled biradicals have been observed. The hyperfine splittings demonstrate independence of the halves. (Contractor's abstract)

2894

Washington U. Dept. of Physics, St. Louis, Mo.

SPIN DENSITY IN PYRENE NEGATIVE ION, by G. J. Hoijtink, J. Townsend, and S. I. Weissman. [1960] [2]p. incl. diagrs. refs. (Technical rept. no. 34) (AFOSR-TN-60-799) (AF 49(638)464) AD 257508 Unclassified

Also published in Jour. Chem. Phys., v. 34: 507-508, Feb. 1961.

Improved resolution has permitted assignment of all proton hyperfine coupling constants in pyrene negative ion. The results are accounted for by a simple calculation of configurational interaction. (Contractor's abstract)

2895

Washington U. [Dept. of Physics] St. Louis, Mo.

SPIN DISTRIBUTION IN ALIPHATIC KETYLS, by N. Hirota and S. I. Weissman. May 1961 [2]p. incl. diagrs. (Technical rept. no. 32) (AFOSR-TN-60-809) (AF 49(638)464) AD 257508 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 4424-4425, Aug. 20, 1960.

Paramagnetic resonance measurements confirm that hexamethylacetone and pentamethylacetone give free radicals with alkali metals. The spectra are those of a radical with the same number of protons as the starting compounds, with spectra due to C^{13} in natural abundance superimposed.

2896

Washington U. [Dept. of Physics] St. Louis, Mo.

ASSOCIATION BETWEEN SODIUM AND NAPHTHALENIDE IONS, by N. M. Atherton and S. I. Weissman. [1960] [5]p. incl. diagr. table, refs. (Technical rept. no. 35) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)464, Office of Naval Research, and Petroleum Research Fund) AD 611690 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 1330-1334, Mar. 20, 1961.

The electron spin resonance spectrum of the naphthalene negative ion in dimethoxyethane has been observed under very high resolution and improved values of the hyperfine coupling constants evaluated. It has been

established that the more complex spectrum of the sodium derivative observed in tetrahydrofuran solution can be attributed to interaction with the sodium nucleus of spin 3/2. The sodium splitting is observed to be temperature dependent, and the existence of an ion-ion pair equilibrium is demonstrated. Sodium splittings were also measured in 2-methyltetrahydrofuran, tetrahydropyran, and dioxane. Suggestions are made concerning a possible structure of the ion pair and the mechanism yielding spin density at the sodium nucleus. (Contractor's abstract)

2897

Washington U. Dept. of Physics, St. Louis, Mo.

A STUDY OF UNIFORM ISOTHERMAL PROCESSING OF NUCLEAR EMULSIONS, by D. A. Kniffen. Sept. 1960, 39p. incl. diagrs. tables, refs. (AFOSR-TN-60-1391) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)833], National Science Foundation, and Office of Ordnance Research) Unclassified

Also published in Nuovo Cimento, Series X, Suppl., v. 21: 55-68, 1961.

An attempt is described to develop an emulsion technique sufficiently simple to allow large scale processing. The experiment consists of fourteen 4 in. x 8 in., 600 μ, ~~G.5~~ Ilford glassbacked emulsions which are exposed to a 1.86 bev/c momentum (80% proton, 20% pion) beam at the Berkeley Bevatron. The emulsions are then developed using variations on the standard amidol developer with variations also in pH, time and temperature. The developed emulsions are then analyzed for variations in grain density with depth. It was concluded that the most favorable results can be obtained with an isothermal development at a temperature of approx 10°C and containing a developer with the following compositions: 3.8 g/liter of amidol, 6.7 g/liter of sodium sulfite, .8 g/liter of potassium bromide and demineralized water to make one liter.

2898

Washington U. Dept. of Aeronautical Engineering, Seattle.

A STUDY OF BOUNDARY CONDITIONS IN SLIP-FLOW AERODYNAMICS, by R. E. Street. [1960] [17]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)440 and National Advisory Committee for Aeronautics under Naw-6486) Unclassified

Published in Proc. of the First Internat'l. Symposium on Rarefied Gas Dynamics, Nice (France) (1960), New York, v. 3: 276-292, 1960. (AFOSR-TN-58-983)

A discussion of the various theories which lead to the simple slip conditions in slip-flow aerodynamics is presented. Particular attention is given to Mott-Smith's solution for the boundary of the Knudsen layer.

2899

Washington U. Dept. of Chemistry, Seattle.

CHEMICAL PHYSICS RELATED TO PHOTOGRAPHY, by W. T. Simpson. Mar. 1960, 4p. (AFOSR-TR-60-43) (AF 18(600)375) AD 253200; PB 152446 Unclassified

Attempts were made to interweave quantum chemistry and experimental electronic state spectroscopy. The work was divided into subclasses: (1) color of dyes where typical photographic sensitizer dyes were investigated and the absorption and emission of monomer and dimer species catalogued and interpreted in order to assign transitions; (2) benzene derivatives, where the nature of the symmetry of the low wave functions for the low-lying states of benzene was studied; (3) 4 π electrons in 3 π orbitals, where theoretical and experimental studies were made on amidinium and amides and on the electron dynamics of the peptide link as found in proteins and in photographic gelatin; and (4) electronic spectrum of molecular crystals, which proposed a classification of crystal spectra into 2 categories by whether the energy transfer is fast or slow compared with the Lissajou's figure motion induced in a single molecule by the act of light absorption. (Contractor's abstract)

2900

Washington U. Dept. of Chemistry, Seattle.

THE ELECTRONIC SPECTRA OF DIPHENYLMETHANE DYES (Abstract), by F. C. Adam. [1960] [1]p. (Bound with its AFOSR-TR-60-43; AD 259200) [AF 18(600)375] Unclassified

Also published in Jour. Molec. Spectros., v. 4: 359-371, Jan. 1960.

The absorption and emission spectra, along with their relative polarizations were obtained for several diphenylmethane dyes. When the transitions are correlated with those of the triphenylmethane dyes, such as Crystal Violet, it is found that the number of observed transitions decreases, as do the number of low-energy resonance structures. The absorption intensities are calculated for the low-energy transitions, and good agreement is found with those observed. (Contractor's abstract)

2901

Washington U. Dept. of Chemistry, Seattle.

S-TETRAZINE. II. INFRARED SPECTRA, by G. H. Spencer, Jr., P. C. Cross, and K. B. Wiberg. Jan. 1960 [20]p. incl. diagrs. table, refs. (Technical note no. 4) (AFOSR-TN-60-68) (AF 18(600)1522) AD 233513; PB 146747 Unclassified

Presented in part at Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 1959.

Also published in Jour. Chem. Phys., v. 35: 1939-1945, Dec. 1961.

To aid in the vibronic analysis of the $n \rightarrow \pi^*$ visible absorption band systems of s-tetrazine vapor, infrared spectra of vapor, solution, and cold, solid film phases of natural and of deuterated mixtures of s-tetrazine have been obtained. By use of the product rule and by correlation of the fundamental modes of s-tetrazine with those of benzene and the other azines, it is possible to make tentative vibrational assignments for all 7 of the fundamental bands that would be expected to be infrared active in the wavelength region from 2 to 15μ. However, the low frequency modes 16a and 16b, A_u and B_{1u}, respectively, have not yet been observed, and the lack of knowledge of the frequencies of 8 of the 9 gerade modes (Raman active only) has prevented any definite assignment of combination bands. The interesting, peculiar observation of what is believed to be the totally symmetrical mode 6a near 730 cm^{-1} in the solid film spectra of the various deuterated mixtures is also reported. (Contractor's abstract)

2902

Washington U. Dept. of Chemistry, Seattle.

s-TETRAZINE. I. ELECTRONIC ABSORPTION SPECTRA AND, IN PARTICULAR, THE VISIBLE $n \rightarrow \pi^*$ VIBRONIC BAND SYSTEMS UNDER HIGH RESOLUTION, by G. H. Spencer, Jr., P. C. Cross, and K. B. Wiberg. Jan. 1960 [37]p. incl. diagrs. tables, refs. (Technical note no. 3) (AFOSR-TN-60-69) (AF 18(600)1522) AD 233496; PB 146746
Unclassified

Presented in part at Symposium on Molecular Structure and Spectroscopy, Ohio State U., Columbus, June 1959.

Also published in Jour. Chem. Phys., v. 35: 1925-1938, Dec. 1961. (Title varies)

The low resolution electronic spectrum of s-tetrazine vapor was measured down to about 190 mμ, and the complex systems of vibronic bands that comprise the $n \rightarrow \pi^*$ visible absorption spectrum were studied under higher resolution. These latter spectra were photoelectrically recorded in the third order of a 21 ft grating spectrograph, using path lengths from 0.05 to 48 m and temperatures from -70 to 70°C. In the absorption regions 4500 to 6100A the spectrum consists of over 500 sharp, vibronic band peaks. Their collected Q-branch maxima were measured to the nearest cm^{-1}. (Contractor's abstract)

2903

Washington U. Dept. of Chemistry, Seattle.

STUDIES IN MOLECULAR SPECTROSCOPY, by P. C. Cross, D. F. Eggers, Jr., and W. T. Simpson. [Final] technical rept. July 15, 1955-Sept. 30, 1959, 11p. (AFOSR-TR-60-3) (AF 18(600)1522) AD 232106
Unclassified

The cyclopropene molecule, C_3H_4, is the only example of a 3-membered ring containing a double bond, and it was studied intensively along with a random deuterium derivative. Study of the pure rotational spectrum enabled determination of the complete structure, which suggests $sp^{2.5}$ hydridization for the CH_2 bonds, and CC distances in the ring uniformly shorter than normal open-chain single and double bond distances. Study of the infrared and Raman spectrum permitted the location of most fundamental vibration frequencies; that of the double bond is 1650 cm^{-1}, much higher than expected. The infrared spectrum of hydrogen sulfide shows some bands with a very odd and unsymmetrical shape; they absorb strongly at frequencies higher than the band center, but very weakly lower than the center. This was explained quantitatively, by treating the molecule as non-rigid, making theoretical calculations of the intensity distribution with the aid of total intensity parameters measured experimentally. Pressure-induced absorption was also discovered in the fundamental SH stretching region. An extensive visible vibronic absorption spectrum of tetrazine was measured and the interpretation as an $n \rightarrow \pi^*$ bands system initiated. (Contractor's abstract)

2904

Washington U. Dept. of Chemistry, Seattle.

PREPARATION AND REACTIONS OF POTASSIUM SILYL, by M. A. Ring and D. M. Ritter. [1960] [4]p. incl. diagrs. refs. (AFOSR-TN-60-817) (AF 18(600)-1541) AD 440594
Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 802-805, Feb. 20, 1961.

A solution of potassium silyl in monoglyme was prepared by the following methods: (1) from silane and potassium or sodium-potassium alloy and (2) from disilane and potassium hydride. Potassium silyl reacted with H_2O, with $HCl_{(g)}$ to produce silane and KCl, and with CH_3Cl to yield methysilane and KCl. The substance also reacted with bromosilane and with diborane in less precisely defined fashion. All these reactions were quantitative, permitting their use for analysis.

2905

Washington U. Dept. of Chemistry, Seattle.

CRYSTAL STRUCTURE OF POTASSIUM SILYL, by M. A. Ring and D. M. Ritter. [1960] [1]p. incl. table. (AFOSR-TN-60-1031) (AF 18(600)1541) AD 260135
Unclassified

Also published in Jour. Phys. Chem., v. 65: 182, Jan. 1961.

Potassium silyl, $KSiH_3$ was examined by x-ray powder diffraction, the first such measurement on a metal derivative of a Group IV hydride. Eight reflections were

observed using Cu K-α radiation on a Philips powder camera of 56.78 mm effective radius, determined using 6 NaCl reflections with correction for absorption error. The structure is cubic of the NaCl type with the K positions at 000, 1/2 1/2 0, 0 1/2 1/2, 1/2 0 1/2, the silicon positions at 00 1/2, 1/2 00, 0 1/2 0, 1/2 1/2 1/2 and a_0 = 7.5 ± 0.02A giving an x-ray density of 1.29 g cm^{-3}.

2906

Washington U. Dept. of Chemistry, Seattle.

BORON AND SILICON COMPOUNDS, by D. M. Ritter. Final rept. [1960] 4p. incl. refs. (AFOSR-TR-60-102) (AF 18(600)1541) Unclassified

The work of this project has been focused upon (1) substitution reactions of boranes, diboranes, and silanes, and (2) synthesis of compounds containing boron-silicon bonds. The substitution reactions have included studies of the reaction of diborane with trimethylborane, the decomposition of monomethyldiborane, and the disproportionation reactions of alkenylboranes and silane derivatives. Synthesis studies have been made on the reactions of potassium dibutylborate with silane, silicon tetrachloride with trimethylchlorosilane, boron hydrides with silanes, and potassium silyl with boron compounds. A list of publications resulting from the work is appended, as well as recommendations for future work.

2907

Washington U. Dept. of Chemistry, Seattle.

SOLUBILITY OF HYDROGEN AND DEUTERIUM IN LIQUID ARGON, by H. Volk and G. D. Halsey, Jr. July 15, 1960, 26p. incl. diagrs. tables, refs. (AFOSR-TN-60-459) (AF 49(638)723) AD 242756 Unclassified

Also published in Jour. Chem. Phys., v. 33: 1132-1139, Oct. 1960.

The solubility of hydrogen and deuterium in liquid argon at pressures from 10 to 100 atm is reported. Solubility isotherms have been measured between 87° and 140°K for hydrogen and between 87° and 120°K for deuterium. The dependence of Henry's constant on temperature, pressure and concentration, the heats of solution, the partial molar vol of hydrogen in liquid argon and the second virial coefficients of hydrogen and deuterium in the liquid solution are reported. The increase in the solubility of deuterium over hydrogen is 21.3%, 20.2% and 18.5%, respectively at 87° 100° 120°K. This isotope effect is discussed as a quantum correction to the free vol. Comparison between theory and experiment indicates that the LJD free volume is too large by approx a factor of 5. (Contractor's abstract)

2908

Washington U. Dept. of Chemistry, Seattle.

SECOND VIRIAL COEFFICIENTS OF NEON, ARGON, KRYPTON AND XENON WITH A GRAPHITIZED CARBON BLACK, by J. R. Sams, Jr., G. Constabaris, and G. D. Halsey, Jr. [1960] [8]p. incl. diagrs. tables, refs. (AFOSR-TN-60-513) (AF 49(638)723) AD 249889 Unclassified

Also published in Jour. Phys. Chem., v. 64: 1689-1696, Nov. 1960.

Precise measurements of the adsorption of neon, argon, krypton, and xenon on the highly graphitized carbon black P33 (2700°) at coverages of less than 10% of the monolayer are reported. These data have been analyzed in terms of a virial coefficients treatment to yield interaction energies and apparent areas. Several models for the interaction potential have been investigated, but no definite choice of a model can be made on the basis of these data. Various theories for obtaining the area from the data are discussed and compared with the usual BET method for determining the area of the black. Values for the isosteric heats of adsorption at zero coverage are also discussed. (Contractor's abstract)

2909

Washington U. Dept. of Chemistry, Seattle.

THE INTERACTION OF H_2, D_2, CH_4, AND CD_4 WITH GRAPHITIZED CARBON BLACK, by G. Constabaris, J. R. Sams, Jr., and G. D. Halsey, Jr. June 29, 1962 [2]p. incl. diagrs. table, refs. (AFOSR-TN-60-774) (AF 49(638)723) Unclassified

Also published in Jour. Phys. Chem., v. 65: 367-368, 1961.

A description is given of an adsorption investigation for the isotopic pairs H_2-D_2 and CH_4-CD_4 on the graphitized carbon black P33 (2700°) in the very dilute range coverages of less than about 10% of the monolayer. Values for the apparent volume extrapolated to zero pressure ranged from approximately 1.9 to 1.5 ml/g for H_2 and D_2 at a temperature range of 90° to 138°K. At higher temperatures the CH_4 and CD_4 volumes were calculated at about 1.9 to 1.6 ml/g. The data are analyzed in terms of a virial coefficients treatment. The pressure was plotted against experimental values of V_x for the H_2-D_2 and CH_4-CD_4 pairs, respectively.

2910

Washington U. Dept. of Physics, Seattle.

AFTERGLOW SPECTROSCOPY, by K. C. Clark. Final summary rept. Mar. 1, 1956-Sept. 15, 1958, 7p. incl. refs. (AFOSR-TR-60-4) (AF 18(603)36) AD 232340; PB 145853 Unclassified

Research operations in the field of afterglows in nitrogen gas mixtures, performed under this contract, are summarized. The purpose of the work was to investigate processes of energy storage and release in nitrogen aftergiows, using spectroscopic and associated techniques. The work has included (1) the design and construction of a vacuum ultraviolet spectrometer, (2) the design and construction of an echelle spectrograph, (3) the development of a diffusion gage for active particles, (4) measurement of atom concentrations, (5) a study of decay by 3-body processes, (6) investigation of exponential decays, (7) measurement of diffusion rates and surface effects, and (8) experiments on quenching and stimulated emission.

2911

Washington U. [Dept. of Physics] Seattle.

DEUTERON MAGNETIC RESONANCE SPECTRUM IN DEUTERATED ROCHELLE SALT (Abstract), by J. L. Bjorkstam and E. A. Vehling. [1960] [1]p. [AF 49-(638)92] Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 345, June 15, 1960.

Although the dielectric anomalies associated with ferroelectric materials were first discovered in Rochelle salt [NaK(tartrate)·$4H_2$)], the complexity of the crystal structure has precluded, to date, a complete analysis. To compliment the available neutron diffraction, infrared, and NMR data an investigation of the NMR spectrum of the deuterated crystal was undertaken. Upon deuteration, all but 2 of the 12 protons in the RS molecule are replaced. As a result of the quadrupolar splitting, this large number of nonequivalent deuterons leads to a very complex spectrum. The over-all splitting is of the order of 200 kc/s. The relaxation time T_1 is less than 1 sec and depends on factors which have to be studied in detail. The nature of the spectrum and its dependence on temperature will be described.

2912

Washington U. [Dept. of Physics] Seattle.

DOMAIN EFFECTS IN THE DEUTERON MAGNETIC RESONANCE SPECTRUM OF KD_2PO_4·Z (Abstract), by E. A. Vehling and J. L. Bjorkstam. [1960] [1]p. [AF 49(638)92] Unclassified

Presented at meeting of the Amer. Phys. Soc., Montreal (Canada), June 15-17, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v 5: 345, June 15, 1960.

In a previous report (item no. WAU.07:001, Vol. II) attention was called to an additional splitting which occurs in the NMR spectrum of the deuteron in the ferroelectric KD_2PO_4 when the crystal is cooled below the Curie temperature. Since the crystal had not been poled into a single domain, the additional splitting was attributed to alternately polarized domains. The magnitude of this additional domain splitting was reasonably consistent with the shear known to occur when the crystal polarizes spontaneously. It was subsequently called to our attention that the possible effects of alternately positioned deuterons in the double minimum hydrogen bond potential and the different frequencies of shuttling between these positions above and below the Curie temperature should be investigated. Consequently, the resonance in the presence of an electric field was studied. These experiments show that polarization of the crystal causes one set of the split lines to disappear. Reversing the direction of polarization brings out the second set of lines in place of the first. These results seem to confirm the belief that the splitting in question is a domain effect.

2913

Washington U. [Dept. of Physics] Seattle.

NUCLEAR SPIN-LATTICE RELAXATION MECHANISMS FOR D IN KD_2PO_4 (Abstract), by V. H. Schmidt, H. B. Silsbee, and E. A. Vehling. [1960] [1]p. [AF 49(638)92] Unclassified

Presented at meeting of the Amer. Phys. Soc., California U., Berkeley, Dec. 29-31, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 497, Dec. 29, 1960.

The individual $\Delta m = 1 (p_1)$ and $\Delta m = 2 (p_2)$ nuclear spin-lattice relaxation transition probabilities for the deuteron in a KD_2PO_4 single crystal were measured as a function of temperature and crystal orientation, and the combined probability $T_1^{-1} = P_1 + 2P_2$ was measured as a function of temperature and magnetic field. Above the ferroelectric Curie point T_c, relaxation is due chiefly to time variations of the electric field gradient (efg) induced by 2 kinds of deuteron motion. The motion most effective above room temperature is the jump motion between hydrogen bonds; P_1 and P_2 calculated from the known jump time and the known efg tensor at the 2 deuteron sites are proportional to $H_0^{-2} \exp(-0.582 \text{ ev/kT})$, in good agreement with experiment. From room temperature down to T_c, deuteron jumps along the hydrogen bond dominates the relaxation process; P_1 and P_2 are proportional to $H_0^0 \exp(-0.078 \text{ ev/kT})$. Differences in the efg tensor consistent with crystal symmetry give the observed angular dependences of P_1 and P_2. Below T_c there is a small transition probability consistent with diffusion to paramagnetic impurities.

2914

Washington U. [Dept. of Physics] Seattle.

NUCLEAR SPIN-LATTICE RELAXATION BY SPIN

DIFFUSION TO PARAMAGNETIC IONS IN KH_2AsO_4 (Abstract), by E. D. Jones, H. B. Silsbee, and E. A. Vehling. [1960] [1]p. [AF 49(638)92] Unclassified

Presented at meeting of the Amer. Phys. Soc., California U., Berkelcy, Dec. 29-31, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 498, Dec. 29, 1960.

The proton relaxation time T_1 has been measured in the temperature and frequency ranges of 225°K to 300°K in 7.5 mc/sec to 20 mc/sec and the results compared with different forms of the spin diffusion theory as discussed most recently by Blumberg. The interpretation of the strong frequency and temperature dependencies were observed in this crystal as evidence that the relaxation is electron rather than diffusion limited. Typical values of T_1 at 300°K are 67 sec and 19 sec at 20 mc/sec and 7.5 mc/sec, respectively, and at 250°K, 87 sec at 20 mc/sec. The data can be fitted to the spin diffusion theory by taking the paramagnetic ion density $N = 7 \times 10^{15}$ cm^{-3}, the electron relaxation time $\tau = 2 \times 10^{-8}$ sec at 300°K with a T^{-2} dependence, and Blumberg's barrier parameter equal to the lattice constant. N and τ are consistent with the intensity and line widths of EPR measurements. By using the numbers given Khutsishvili's distance parameter is estimated and found to be consistent with the assumption of electron-limited relaxation.

2915

Wayne State U. Dept. of Chemistry, Detroit, Mich.

PREPARATION OF LARGE AREA SINGLE-CRYSTAL CUPROUS OXIDE, by S. Toth, R. Kilkson, and D. Trivich. [1960] [5]p. incl. illus. diagr. refs. (AFOSR-TN-60-262) (AF 18(600)481) AD 240471 Unclassified

Also published in Jour. Appl. Phys., v. 31: 1117-1121, June 1960.

Large area single crystals of Cu_2O were grown by the process of high temperature annealing. Cu_2O was prepared in finely polycrystalline form by the complete oxidation of Cu plate in air at temperatures of 1020°-1050°C. Subsequent annealing of the polycrystalline plates at higher temperatures allowed secondary recrystallization to occur. Single-crystal grains having surface areas larger than 1 sq-in. were grown consistently on Cu_2O plates having thicknesses of 0.010 in. to 0.060 in. In some cases, entire polycrystalline plates were transformed into single crystals, and as a result, individual single crystals having surface areas of 3 sq-in. and larger were obtained. The annealing temperature and the annealing time were found to depend markedly on the plate thickness. Thick plates required lower temperatures and longer annealing times than the thinner plates. X-ray analysis of the large grains verified that they were single crystals without excess strain, and indicated preferred orientation, with the (211) and (311) planes predominating. Resistance profile measurements at room temperature on quenched samples showed that a variation in resistance exists through the thickness of the plate. (Contractor's abstract)

2916

Wayne State U. Dept. of Chemistry, Detroit, Mich.

PREPARATION OF LARGE AREA SINGLE CRYSTAL CUPROUS OXIDE AND THE ELECTRICAL CONDUCTIVITY OF SINGLE CRYSTAL CUPROUS OXIDE AT HIGH TEMPERATURES, by R. S. Toth, R. Kilkson, and D. Trivich. Apr. 30, 1960 [90]p. incl. diagrs. tables, refs. (Technical rept. no. 2) (AFOSR-TN-60-485) (AF 18(600)481) AD 240469; PB 149759 Unclassified

A method has been developed for the preparation of single crystals of cuprous oxide in the form of thin sheets of large area. The cuprous oxide was prepared initially in polycrystalline form by oxidation of copper sheet in air at temperatures below 1050°C. Subsequent annealing of the polycrystalline cuprous oxide sheet at higher temperatures, from 1070 to 1130°C, caused the grains to grow to large size, frequently attaining sizes of greater than a square inch in area. The process for preparing single crystal cuprous oxide was effective only on thin sheets, less than 0.060 in. thick. The effective temperature and annealing time depended upon thickness so that the thinner sheets required the higher temperatures and shorter times. The single crystal character of the large grains was verified by x-ray examination, which further showed that the crystals were not strained and that preferred orientations of [211] and [311] existed. The electrical conductivity of the single crystal cuprous oxide was measured in the temperature range of 1100°C to 500°C at oxygen pressures from 152 mm to 10^{-5} mm. The plot of the logarithm of the conductivity against the logarithm of the oxygen pressure at constant temperature was found to be linear over a pressure range of 50 mm to 10^{-2} mm, with a slope of 0.1420 (approximately 1/7). The curve departs from linearity at lower pressures and also goes through a minimum with decreasing pressure. The activation energies, obtained from the straight line plots of the logarithm of the conductivity against the reciprocal of the absolute temperature, gave essentially constant values of 0.65 ev at oxygen pressures from 50 mm to 10^{-2} mm. At pressures of 10^{-3} and 10^{-4} mm, the activation energy increased sharply to 1.05 ev. The conductivity in air at temperatures of 1020° to 1100°C gave an activation energy of 0.767 ev. (Contractor's abstract)

2917

Wayne State U. Dept. of Chemistry, Detroit, Mich.

THE PROPERTIES OF ELECTROLYTICALLY PREPARED CUPROUS OXIDE AND THE EFFECT OF SULFIDING ON THE PROPERTIES OF CUPROUS OXIDE PHOTOVOLTAIC CELLS, by R. S. Toth, N. Economou, and D. Trivich. Apr. 30, 1960, 46p. incl. diagrs. tables, refs. (Technical rept. no. 3) (AF 18(600)481) AD 240470; PB 149760 Unclassified

A method of preparing thin films of Cu_2O by an electrodeposition technique has been developed for the study of these films. The basic properties of these films differ only slightly from results on thermally prepared Cu_2O except that water has been found to be incorporated in the deposit. This can be eliminated by annealing at a proper temperature. The sulfide treatment of the Cu_2O surface of a copper oxide photovoltaic cell has been found to affect only slightly the output of thermally prepared cells. Sulfiding on electrolytically prepared cells was found to increase the power output by a factor of 10^2 to 10^3. The reason for the increased output is the lowering of the series resistance of the cells by the sulfide layer and a consequent increase in the efficiency of collection of the carriers produced at the photosensitive junction. This effect is larger for high resistance electrolytic Cu_2O than for the lower resistance thermal Cu_2O. The effect of the sulfiding treatment on the photovoltaic output can be maximized by proper selection of sulfide layer thickness and geometry of the top contact. (Contractor's abstract)

2918

Wayne State U. Dept. of Chemistry, Detroit, Mich.

PREPARATION AND PROPERTIES OF CUPROUS OXIDE AND CUPROUS OXIDE PHOTOVOLTAIC CELLS, by D. Trivich and R. S. Toth. Final rept. Aug. 1960 [30]p. incl. refs. (Technical rept. no. 4) (AFOSR-TR-60-125) (AF 18(600)481) AD 245116; Lf 152694 Unclassified

The electrodeposited cuprous oxide photovoltaic cells were found to be much less efficient for energy conversion than the thermal cells but they were considerably improved by a sulfiding process. The mechanism of the sulfide sensitization was shown to be due to a highly conducting surface film of cuprous sulfide which lowered the series resistance of the cells. The electrodeposited cuprous oxide had a very fine crystal size but the same crystal structure as the thermal cuprous oxide. The resistance of the electrolytic cuprous oxide was much higher than that of the thermal material, thus making it more susceptible to the sulfiding treatment. The visible and infrared spectra of the 2 types of cuprous oxide were similar except that the electrolytic material had additional absorption bands at 3.04 and 6.05μ. Ionic bombardment with hydrogen produced the desired front junctions on thermal cuprous oxide, and in doing so reduced the top surface to copper. The resulting cells had an efficiency of about 1% for the conversion of solar energy to electrical energy, considerably greater than that of the back-wall cells. Efforts were made to produce cuprous oxide in single crystal form. A successful method was developed, using a grain growth process at high temperature. The electrical conductivity of the single crystal cuprous oxide was measured at high temperatures and various oxygen pressures. At constant temperature, the conductivity varied with the 1/7th power of the oxygen pressure at not too low pressures. At constant oxygen pressure, the logarithm of the conductivity varied linearly with the reciprocal of the absolute temperature, and from these linear plots activation energies were calculated.

2919

Wayne State U. Dept. of Chemistry, Detroit, Mich.

ELECTRICAL CONDUCTIVITY OF SINGLE-CRYSTAL CUPROUS OXIDE AT HIGH TEMPERATURES, by R. S. Toth, R. Kilkson, and D. Trivich. [1960] [7]p. incl. diagrs. tables, refs. [AF 18(600)481] Unclassified

Published in Phys. Rev., v. 122: 482-488, Apr. 15, 1961.

The electrical conductivity of single-crystal Cu_2O was measured in the temperature range of 1100° to 500°C in oxygen pressures from 152 mm to 10^{-5} mm of Hg. The $\log \sigma$ vs $\log P(O_2)$ curves were found to be linear between the oxygen pressures of 50 mm and 10^{-2} mm, with an average slope of 0.1420, or approximately 1/7. These curves exhibit a radical change in slope at O_2 pressures below 10^{-2} mm. The plots of $\log \sigma$ vs 1/T at constant oxygen pressure were found to be linear and the activation energies obtained from the slopes of these plots have an average value of 0.65 ev at O_2 pressures between 50 mm and 10^{-2} mm. At O_2 pressures of 10^{-3} mm to 10^{-4} mm, the activation energy increases sharply to a value of 1.05 ev. The activation energy obtained from the measurement of single-crystal Cu_2O in air at temperatures from 1020°C to 1100°C was found to have an average value of 0.767 ev. An explanation for the physical significance of the activation energies obtained is suggested and the models proposed to explain the dependence of the electrical conductivity on the O_2 pressure are considered. (Contractor's abstract)

2920

Wayne State U. [Dept. of Mathematics] Detroit, Mich.

CONFORMAL MAPS OF ALMOST KAEHLER MANIFOLDS, by S. I. Goldberg. Jan. 1960, 19p. (AFOSR-TN-60-95) (AF 49(638)14) AD 232556; PB 146087 Unclassified

Also published in Tôhoku Math. Jour., Series II, v. 13: 119-131, Apr. 1961.

Groups of conformal maps of almost Kaehler manifolds are studied. The following theorem is proved: The largest connected Lie group of conformal transformations of a compact almost Kaehler manifold M^{2n} $(n > 1)$ coincides with the largest connected group of automorphisms of the almost Kaehler structure. This generalizes a corresponding theorem established by Lichnerowicz for Kaehler manifolds. By restricting the conformal maps to those whose associated 1-forms are closed, a much wider class of manifolds may be considered.

2921

Wayne State U. [Dept. of Mathematics] Detroit, Mich.

PROBLEMS ON CONFORMAL MAPS OF RIEMANNIAN AND KAEHLERIAN MANIFOLDS, by S. I. Goldberg. July 1960, 20p. incl. refs. (AFOSR-TN-60-867) (AF 49(638)14) AD 244303; PB 152436 Unclassified

Some problems on conformal maps of Riemannian and Kaehlerian manifolds are studied. Let M^m be a compact and orientable Riemannian manifold with metric g on which there is defined an harmonic p-form α whose coefficients $a_{i_1 \ldots i_p}$ satisfy the property (P): $a_{i}^{\ i_2 \ldots i_p} a_{j i_2 \ldots i_p} = g_{ij}$. Such a space is called an H(m, p). For p = 2 the metric of any Riemannian space with an almost complex structure can be modified so that (P) is satisfied. It is well-known that a compact semi-simple Lie group carries an harmonic 3-form satisfying (P). In the technical note (WAY. 04:001, Vol. II) the spaces K(m, p) were studied; the spaces H(M, p) form a more general class. It is shown that an infinitesimal conformal transformation of an H(m, p), m > 2p is an infinitesimal isometry. This generalizes the principal results of earlier works including item nos. 2203, Vol. III and 2920, Vol. IV. Conformal maps of non compact manifolds are also studied. (Contractor's abstract)

2922

Wayne State U. [Dept. of Mathematics] Detroit, Mich.

GROUPS OF AUTOMORPHISMS OF ALMOST KAEHLER MANIFOLDS, by S. I. Goldberg. [1960] [4]p. (AF 49-(638)14) Unclassified

Published in Bull. Amer. Math. Soc., v. 66: 180-183, May 1960.

Results similar to those of A. Lichnerowicz (Bull. Math. Soc. Sci. Math. Phys. R. P. Roumaine, v. 2: 165-174, 1958) except for the more general case of almost Kaehler manifolds are announced. Moreover, some results are obtained for Kaehler and almost Kaehler manifolds which do not require compactness. In particular, the theorems obtained are: (1) the theorem cited by A. Lichnerowicz with replacement of Kaehler by almost Kaehler manifolds; and (2) if the 1-form ξ corresponding to an infinitesimal conformal transformation X is closed and V_{2n} is a complete Kaehler manifold (n > 1), then it is infinitesimal automorphism of the Kaehler structure except that if the manifold is locally flat, then it is further required that the length of X be bounded. (Math. Rev. abstract)

2923

[Wayne State U. Dept. of Mathematics, Detroit, Mich.]

HOELDER CONTINUITY AND INITIAL VALUE PROBLEMS OF MIXED TYPE DIFFERENTIAL EQUATIONS, by Y. W. Chen. [1959] [26]p. incl. refs. (AFOSR-TN-60-250) (AF 49(638)107) Unclassified

Also published in Comment. Math. Helv., v. 33: 296-321, 1960.

The H. Lewy method of treatment of partial differential equations of elliptic type with analytic coefficients is extended to mixed type equations and used to treat a typical problem such as the behavior of the solutions of the Tricomi equation when the singular line is approached from the elliptic part of the domain. The question of continuation of solutions on and near the boundary, and the functional behavior of the solutions is investigated.

2924

Wayne State U. [Dept. of Mathematics] Detroit, Mich.

ENTIRE SOLUTIONS OF A CLASS OF DIFFERENTIAL EQUATIONS OF MIXED TYPE, by Y. W. Chen. [1960] [27]p. incl. refs. (AFOSR-TN-60-251) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)107 and Atomic Energy Commission under AT(30-1)1480) Unclassified

Also published in Commun. Pure and Appl. Math., v. 14: 229-255, Aug. 1961.

This is a study of solutions of $Y^m U_{xx} + U_{yy} = 0$, $m > 0$ (or, equivalently, of $u_{xx} + u_{yy} + 2\alpha y^{-1} u_y = 0$, $y = (y/k)^k$, $U(x, Y) = u(x, y)$, $k = 2/(m+2)$, $2\alpha = 1-k$) defined on halfplane $Y > 0$ with the initial data $U(\cdot, 0) = u_0$, $U_y(\cdot, 0) = u_1$. It is assumed that u_0 has the fractional derivative $I_0^{-k} u_0 = u_k$ based on zero, and that u_k, $u_1 \in L_p(R)$, $p > 1$; the value $p = 1/k$ is excluded from all considerations. An integral representation for u and the following is shown. (1) An entire solution exists if and only if u_0 and u_1 are related by $u_1 = A(\cos \alpha\pi \hat{u}_k^* + \sin \alpha\pi \hat{u}_k)$, where $\hat{u}_k = I_{-\infty}^{-k} u_0$, $\hat{u}_k^*(x) = \pi^{-1} \int_{-\infty}^{\infty} (x-t)^{-1} \hat{u}_k(t)dt$, A is a number; (2) $\|I_0^{-k} u(se^{i\theta})\|_p \le C\|u_k\|_p$, $\|y^{2\alpha} s^{-1} u_\theta(se^{i\theta})\|_p < C\|u_1\|_p$ ($se^{i\theta} = x + iy$), where the integrals are computed along rays θ = constant; (3) $\|I_0^{-k} u(se^{i\theta}) - u_k\| \to 0$, $\|y^{2\alpha} s^{-1} u_\theta(se^{i\theta}) - u_1\|_p \to 0$ as $\theta \to 0$, π. Uniqueness is established but requires an additional growth condition when $p > 1/k$. When $p > 1/k$, a second integral representation yields results (2) and (3) above in which the integration is along the lines y = constant. A part of the paper is devoted to the study of fractional derivatives of functions in $L_p(R)$ and concerns primarily the representation of given functions by fractional derivatives based at different points. (Math. Rev. abstract)

2925

Wayne State U. Dept. of Mathematics, Detroit, Mich.

ON THE HOMOTOPY PROPERTIES OF THE

COMPONENTS OF THE MAPPING SPACE X^{S^p}, by S. S. Koh. Mar. 1960 [14]p. incl. refs. (Technical note no. 7) (AFOSR-TN-60-272) (AF 49(638)179) AD 235378; PB 146766 Unclassified

Also published in Proc. Amer. Math. Soc., v. 11: 898-904, Dec. 1960.

The objective of the present note is to study whether the various components of the mapping space of all continuous maps from a given sphere S^p into another sphere S^r are of the same homotopy type. Because of the recent results of the homotopy groups of spheres, more general information about the homotopy types of these components can be deduced than the existing results found by G. W. Whitehead and S. T. Hu (Ann. Math., v. 47: 460-475, 1946; and Indeg. Math., v. 7: 621-629, 1946). (Contractor's abstract)

2926

Wayne State U. Dept. of Mathematics, Detroit, Mich.

ON AXIOMATIC APPROACH TO HOMOLOGY THEORY WITHOUT USING THE RELATIVE GROUPS, by S.-T. Hu. Apr. 1960, 17p. (Technical note no. 8) (AFOSR-TN-60-371) (AF 49(638)179) AD 237158; PB 148023 Unclassified

Also published in Portugal. Math., v. 19: 211-225, 1960.

A new axiomatic approach to homology theory which does not use the relative groups, proposed by D. Puppe (Ann. Math., v. 67: 239-281, 1958) is discussed. Puppe's theory is formulated in terms of the (absolute) homology groups, the induced homomorphisms, and the suspension isomorphisms. The uniqueness theorem is proved for all CW-complexes by removing Puppe's base point, which served only in the proof for connected CW-complexes. In the last two sections, the relative homology groups and the boundary homomorphisms are constructed so as to obtain a homology theory in the sense of Eilenberg and Steenrod for the category of all CW-complexes.

2927

Wayne State U. Dept. of Mathematics, Detroit, Mich.

AN AXIOMATIC APPROACH TO HOMOTOPY THEORY WITHOUT USING THE RELATIVE GROUPS, by S.-T. Hu. June 1960, 12p. (Technical note no. 9) (AFOSR-TN-60-641) (AF 49(638)179) AD 241443; PB 150058 Unclassified

Also published in Portugal. Math., v. 20: 95-103, 1961.

The existing axiomatic approach to homotopy theory is formulated in terms of the relative homotopy groups, the boundary homomorphisms, and the induced homomorphisms. An axiomatic approach is introduced without using the relative homotopy groups. (Contractor's abstract)

2928

Wayne State U. Dept. of Mathematics, Detroit, Mich.

ABSTRACT HOMOTOPY THEORY, by S. S. Koh. Dec. 1960, 211p. incl. diagrs. (Technical note no. 11) (AFOSR-TN-60-1223) (AF 49(638)179) AD 250732 Unclassified

A detailed exposition of the abstract homotopy theory is given in terms of complete semi-simplicial complexes satisfying the extension condition introduced by D. M. Kan. An introduction to the topic is given followed by sections on homotopy theory on complete semi-simplicial complexes, homotopy and complete semi-simplicial fiberings, complete semi-simplicial groups, and the geometrical realization of a complete semi-simplicial complex.

2929

[Wayne State U. Dept. of Mathematics, Detroit, Mich.]

FIBERINGS OF ENVELOPING SPACES, by S.-T. Hu. Oct. 1960, 36p. (Technical note no. 10) (AFOSR-TN-60-1224) (AF 49(638)179) AD 246491; PB 153177 Unclassified

Also published in Proc. London Math. Soc., v. 11: 691-707, Oct. 1961.

Since the enveloping spaces and the residual spaces were shown to be very useful in distinguishing spaces of the same homotopy type, the homology groups and the homotopy groups of the enveloping spaces of a manifold are computed. For this purpose, the fact is established that the natural projection is a fibering. The method of fiber spaces can be applied and most of the groups can be computed. (Contractor's abstract)

2930

Wayne State U. Dept. of Physics, Detroit, Mich.

L/F NOISE IN SINGLE-CRYSTAL GERMANIUM FILAMENTS, by V. E. Noble and J. E. Thomas, Jr. Mar. 1, 1960 [102]p. incl. illus. diagrs. refs. (Technical note no. 4) (AFOSR-TN-60-311) (AF 49(638)158) AD 237104; PB 147774 Unclassified

The variation of 1/f noise in germanium filaments as a function of the surface potential has been investigated by varying the gaseous ambient surrounding the noise sample. Noise measurements on 32 ohm cm n-type, 8.5 ohm cm n-type, and 9 ohm cm p-type material showed a definite noise minimum when the value of the surface potential corresponded with the sample conductance minimum. Noise amplitude calculations, based on McWhorter's majority carrier trapping effect, were within a factor of 2 of the observed accumulation-layer noise in the case of the near-intrinsic material. The inversion-layer noise was greater than both the predicted value and the observed accumulation-layer noise. (Contractor's abstract)

2931

Wayne State U. Dept. of Physics, Detroit, Mich.

THE ARC IMAGE FURNACE FOR GROWING SEMICONDUCTOR CRYSTALS, by R. P. Poplawsky and J. E. Thomas, Jr. Mar. 1, 1960, 106p. incl. illus. diagrs. tables, refs. (Technical note no. 3) (AFOSR-TN-60-312) (AF 49(638)158) AD 239133; PB 161868 Unclassified

The optical, mechanical, and electrical details of an arc image furnace are given. This furnace uses two 60" parabcioidal reflectors in vertical arrangement with a high intensity carbon arc as the source. It was designed to study arc image crystal growing techniques. Two crucible-free techniques, pushing and pulling, which resulted in the growth of several arc image silicon crystals are discussed. The results of measurements made on these crystals show that they are essentially free of oxygen, have high resistivities when a good grade of bulk material is used, and have a dislocation density of the order of 10^4 cm^{-2}. The factors which influence the growth and quality of arc image crystals are discussed, e.g., maximum useful furnace power, shapes of floating zones, and radiant flux considerations. (Contractor's abstract, modified)

2932

Wayne State U. Dept. of Physics, Detroit, Mich.

OBSERVATIONS OF SURFACE TRANSVERSE MAGNETORESISTANCE EFFECTS ON N-TYPE GERMANIUM, by W. A. Albers, Jr. and J. E. Thomas, Jr. Mar. 1, 1960, 87p. incl. diagrs. table, refs. (Technical note no. 2) (AFOSR-TN-60-313) (AF 49(638)-158) AD 239134; PB 148762 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 14: 181-185, July 1960.

Two techniques were developed for preparing large surface-to-volume ratio single crystal samples for surface studies. In both cases the methods depend on having, initially, thick slices of semiconductor single crystal material. This material is then either made the anode of an electrolytic cell and illuminated with near-IR so that the sample etches thin in the illuminated region, or it is exposed to a flowing stream of an acid mixture and subsequently etched thin by the resulting chemical reactions. Several thin samples of n-type germanium were prepared. The electrical conductivity and the magnetoresistance of these samples were simultaneously measured as a function of the surface conditions of the sample. These measurements yielded one of the first direct observations of the mobility of electrical carriers near the surface of a semiconductor. They also show that transport processes at the surface can be treated by the same concepts that apply to transport processes in the bulk, provided the variations of the mobility with surface condition are taken into account. (Contractor's abstract, modified)

2933

Wayne State U. Dept. of Physics, Detroit, Mich.

SURFACE PHENOMENA IN SEMICONDUCTOR CRYSTALS, by W. A. Albers, Jr., V. E. Noble and others. Mar. 1, 1960 [35]p. incl. illus. diagrs. table, refs. (AFOSR-TR-60-41) (AF 49(638)158) AD 239132; PB 161867 Unclassified

Investigations were made into 2 areas of vital interest to semiconductor research and applications. The first area was semiconductor surface phenomena. The second area was the preparation of hyperpure semiconducting materials which may be used both in future research and in device technology. A photo-electric etching technique was developed for the preparation of thin filaments of single crystal germanium. Magnetoresistance measurements made on these thin samples yielded what is believed to be 1 of the first direct observations of the mobility of electrical carriers near the surface of a semiconductor. They also yielded the conclusion that transport processes at the surface can be treated by the same concepts that apply to transport processes in the bulk, provided the variations of the mobility with the surface condition are taken into account. The problem of preparing hyper-pure crystals of semiconducting materials was attacked by employing a radiant power source; in this case a high intensity carbon arc. This type of radiant power source combined with reflecting optics and floating zone techniques has yielded several high purity silicon crystals which are essentially free of oxygen and which have a lower average dislocation density than floating silicon prepared in the usual way.

2934

Wayne State U. [Dept. of Physics] Detroit, Mich.

FLOATING ZONE CRYSTALS USING AN ARC IMAGE FURNACE, by R. P. Poplawsky and J. E. Thomas, Jr. [1960] [6]p. incl. illus. diagrs. table, refs. [AF 49-(638)158] Unclassified

Published in Rev. Scient. Instr., v. 31: 1303-1308, Dec. 1960.

A floating zone technique for growing crystals of medium high melting point materials with an arc image furnace is presented. This technique has been successfully applied to silicon. The oxygen concentration, resistivities, and dislocation densities of resulting crystals are determined to make possible a comparison with crystals obtained by standard method. In general this comparison is favorable. Considerations of floating zones, maximum power, and flux distribution indicate that floating zone techniques combined with an arc image furnace are promising in connection with the growth of good quality crystals of a variety of high melting point materials. (Contractor's abstract)

2935

Wayne State U. Dept. of Physics, Detroit, Mich.

SOME FERMI SURFACE MEASUREMENTS IN SILVER, by H. V. Bohm. [1960] [6]p. incl. diagrs. [AF 49(638)-832] Unclassified

Also published in Proc. Internat'l. Conf. on the Fermi Surface of Metals, Cooperstown, N. Y. (Aug. 22-24, 1960), New York, Wiley and Sons, 1960, p. 245-250. (AFOSR-395)

Measurements at liquid helium temperatures using ultrasonic pulses of frequencies above 100 mc/sec have been made in a single crystal silver sample. The attenuation was examined as a function of magnetic field strength and direction. Results are compared with those of Morse et al, and Mielczarek et al. Some previously unreported Fermi momenta are given. Some shear wave data, the interpretation of which is not clear, is also presented. (Contractor's abstract)

2936

Weizmann Inst. of Science. Dept. of Applied Mathematics, Rehovoth (Israel).

TABLES FOR THE CALCULATION OF LATTICE SUMS, by P. Rabinowitz and G. Weiss. [1960] [2]p. [AF 61(052)352] Unclassified

Published in Journ. Chem. Phys., v. 33: 1272-1273, Oct. 1960.

This is a mathematical description of six types of tabulated functions. The tables were prepared by direct summation of all terms less than 10^{-35} in magnitude and can be obtained as Document number 6393 from the ADI Auxiliary Publications Photoduplication Serivce, Library of Contress, Washington, D. C.

2937

Weizmann Inst. of Science. Dept. of Biophysics, Rehovoth (Israel).

A WATER-INSOLUBLE TRYPSIN DERIVATIVE AND ITS USE AS A TRYPSIN COLUMN, by A. Bar-Eli and E. Katchalski. [1960] [2]p. (AFOSR-735) (Sponsored jointly by Air Force Office of Scientific Research under AF 61(052)391 and National Institutes of Health under A-3083) AD 256719 Unclassified

Also published in Nature, v. 188: 856-857, Dec. 3, 1960.

A polytyrosyl trypsin containing tyrosyl peptide side chains was prepared by initiating the polymerization of N-carboxy-L-tyrosine anhydride with trypsin. The trypsin derivative thus obtained was water-soluble and retained full enzymic activity. On coupling with a diazotized copolymer of p-aminophenylalanine and leucine it yielded the required water-insoluble trypsin. The latter served for the preparation of an active trypsin column.

2938

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

ON A MODIFIED BETHE-GOLDSTONE EQUATION, by A. Katz. Feb. 1, 1960 [38]p incl. diagrs. (Technical note no. 1) (AFOSR-TN-60-307) (AF 61(052)337) AD 234518; PB 146421 Unclassified

Also published in Nuclear Phys., v. 18: 177-195, Aug. 1960.

A many fermion system with Bardeen, Cooper, and Schrieffer interaction (Phys. Rev., v. 108: 1175, 1957) is treated by a modified Bethe-Goldstone equation which takes into account a self consistent spreading of the Fermi surface. The method employs a modified wave function which is an eigenstate of one modified Hamiltonian and from which energies are determined by another. Pairs with total momentum O are treated as elementary entities. All modifications are achieved by a "projection operator" which a priori takes care of the interference between pairs due to their statistics. The only case solved is the one where all interacting pairs go into the Cooper state (Phys. Rev., v. 104: 1189, 1956) of the modified Hamiltonian. The results are identical with those of Bardeen et al. (Contractor's abstract)

2939

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

MANY-BODY PERTURBATION METHODS IN A SOLUBLE MODEL, by A. Katz. Mar. 1, 1960, 53p. incl. diagrs. refs. (Technical note no. 2) (AFOSR-TN-60-802) (AF 61(052)337) AD 241486; PB 150041 Unclassified

Also published in Nuclear Phys., v. 20: 663-689, Nov. 1960.

Because statistics should not be obeyed in Goldstone's perturbation expansion there exist 2-body contributions from diagrams other than ladders. The role of diagrams with "wrong" statistics is investigated in a model in which the perturbation is a single particle potential. A summation of all diagrams is carried out in this model and compared to the sum of all ladders. The "wrong statistics" contributions are important in deciding the region of convergence of the series and the location and nature of the singularities which limit it. While the region of convergence of the series of ladders is limited by a pole on the real axis, the radius of convergence of the complete series (which is smaller) is marked off by 2 branching points off the real axis. The formal sum of all diagrams displays a finite discontinuity at that point of the real axis where the ladders have a pole, thus changing from 1 branch to another. Each branch can be continued analytically through this discontinuity which is not a singularity of either branch. The ladders approximate only 1 branch, turning the finite discontinuity into a pole and thus 1 branch corresponding to the Cooper state, is lost. The remaining branch is described quite well by Brueckner's ladders even outside the region of convergence of the power series. It corresponds to the

"normal" state. In the case of 2-body interactions with short range and low density the most important contributions with wrong statistics are the 2-body contributions of "many body diagrams". Their inclusion is equivalent to using the Cooper type solution of a Bethe-Goldstone equation. (Contractor's abstract)

2940

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

COLLECTIVE MOTION IN MANY-PARTICLE SYSTEMS. PART II. TREATMENT OF COUPLED SYSTEMS, by H. J. Lipkin. July 1, 1960, 13p. incl. table. (Technical note no. 4) (AFOSR-TN-60-1142) (AF 61(052)337) AD 244300 Unclassified

Also published in Ann. Phys., v. 12: 452-462, Mar. 1961.

A collective motion is presented for using independent particle wave functions to treat cases where there is coupling between the collective modes and the other degrees of freedom of the system. The method is shown to be equivalent to the use of redundant variables and canonical transformations, but is simpler and more easily interpreted. The wave functions are considered to be trial functions which give a good approximate description of all the degrees of freedom except the collective modes. A simple model of center of mass motion with additional coupling is used to illustrate the method.

2941

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

ON THE CALCULATION OF THE t-MATRIX FOR POTENTIALS WITH A HARD CORE, by J. M. J. Van Leeuwen and A. S. Reiner. [1960] [12]p. (AFOSR-99) [AF 61(052)337] AD 253340 Unclassified

Published in Physica, v. 27: 99-110, Jan. 1961.

An explicit calculation of the t-matrix for general complex argument is described for potentials consisting of a chain of rectangular wells. Details are given for the hard sphere interaction and the Herzfeld potential. The method is compared with the resolvent method, pointing out the care needed when a hard core is present in the interaction. (Contractor's abstract)

2942

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

THE MOMENT OF INERTIA OF ROTATING NUCLEI, by A. Katz and J. Blatt. Nov. 1960, 34p. incl. refs. (Technical note no. 6) (AFOSR-169) (AF 61(052)337) AD 253341; PB 155420 Unclassified

Also published in Nuclear Phys., v. 23: 612-629, Mar. 1961.

A method developed for superconductivity and the Meissner effect is applied to the calculation of the rotational moment of inertia of superfluid systems. It is checked that the correct mass is obtained in an analogy translational problem. The expressions for the moment of inertia are equivalent to those of A. B. Migdal (Nuclear Phys., v. 13: 655, 1959).

2943

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

PAIRING AND QUADRUPOLE FORCES IN A TWO-DIMENSIONAL SOLUBLE MODEL, by H. J. Lipkin. Nov. 1, 1960, 22p. incl. refs. (Technical note no. 7) (AFOSR-170) (AF 61(052)337) AD 253342; PB 155427 Unclassified

Also published in Nuclear Phys., v. 26: 147-160, July 1961.

The model treated is a system of particles moving in a 2-dimensional harmonic oscillator with 2-body pairing and quadrupole forces mixing states within a single major shell. A simple representation is found in which the Hamiltonian is exactly diagonal. An "energy gap" is obtained in the limit of pure pairing forces and rotational spectra in the limit of pure quadrupole forces. In the intermediate region the spectrum varies from energy gap to rotational as the number of particles is increased. The effective moment of inertia of the rotational band is unaffected by the pairing force, remaining constant at the value for a pure quadrupole force. The model is also treated by replacing the quadrupole force by a self-consistent deformed field and the moment of inertia is calculated using the cranking model. The results agree with the exact solution. Implications of the model for more realistic cases are discussed. (Contractor's abstract)

2944

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

ELECTRIC MONOPOLE TRANSITIONS IN COLLECTIVE NUCLEI, by A. S. Reiner. Nov. 1, 1960, 30p. incl. tables, refs. (Technical note no. 8) (AFOSR-171) (AF 61(052)337) AD 253343; PB 155421 Unclassified

Also published in Nuclear Phys., v. 27: 115-133, Sept. 1961.

Electric monopole transitions are studied in nuclei with phonon and rotation-vibration spectra. Reduced transition probabilities are derived in a model which assumes incompressibility of nuclear matter and are compared with rates of competing E2 Gamma transitions. In the latter are for the strong-coupling model included appreciable effects due to rotation-vibration interaction. The derived branching ratios turn out to be essentially independent of nuclear parameters. In spite of a

remarkable consistency of the model, as shown for instance in various calculations of the zero-point fluctuation amplitude of the Beta vibrations, serious discrepancies in branching ratios are observed. Those are tentatively ascribed to the assumption of incompressibility of nuclear matter in the surface layer.

2945

Western Ontario U. Dept. of Physics, London (Canada).

ABLATION STUDIES IN A SHOCK TUBE, by R. W. Nicholls, W. H. Parkinson, and H. Van der Laan. [1959] [2]p. incl. table, refs. (Sponsored jointly by Air Force Cambridge Research Center under AF 19(604)-4540, [Air Force Office of Scientific Research under AF 49(638)640], Department of Defence Production of Canada, National Research Council of Canada, and Ontario Research Foundation) Unclassified

Published in Jour. Appl. Phys., v. 30: 797-798, May 1959.

Report is made of the direct measurement of ablation from small spherical particles of iron arising from their transient immersion in the hot gas behind reflected helium driven shock waves in argon. Three specimens, each of approx 1g, were shock excited near the window of a shock tube at respective incident Mach numbers of 4.6, 5.6, and 6.7. The incident Mach numbers, reflected shock wave pressures (P_5), and temperatures (T_5) were calculated from standard 1-dimensional shock wave theory. The effective radius $\bar{r}$ equivalent to the most probable effective area was easily calculated through knowledge of the linear magnification of the whole system. At M = 4.6, 5.6, and 6.7, the corresponding values obtained were, respectively: P_5 = 9680, 6300, and 2950; T_5 = 4900, 7200, and 10,200°K; and $\bar{r}$ = 4.21, 3.78, and 3.34.

2946

Western Ontario U. Dept. of Physics, London (Canada).

SIMPLIFIED ANALYTICAL REPRESENTATION OF KLEIN-DUNHAM POTENTIAL ENERGY FUNCTIONS, by W. R. Jarmain. [1959] [2]p. (Sponsored jointly by Air Force Cambridge Research Center under AF 19-(604)4560, [Air Force Office of Scientific Research under AF 49(638)640], Defence Research Board of Canada, Department of Defence Production of Canada, and National Research Council of Canada) Unclassified

Published in Jour. Chem. Phys., v. 31: 1137-1138, Oct. 1959.

Ree's analytical treatment of the Klein-Rydberg potential has been generalized, and except for cases when only two vibrational constants are known or higher order constants are significant, the computations are greatly simplified. It has been established that the Dunham potential is identical with that of Klein-Rydberg.

2947

Western Ontario U. Dept. of Physics, London (Canada).

KLEIN-DUNHAM POTENTIAL ENERGY FUNCTIONS IN SIMPLIFIED ANALYTICAL FORM, by W. R. Jarmain. [1959] [14]p. incl. tables, refs. (Sponsored jointly by Air Force Cambridge Research Center under AF 19(604)4560, [Air Force Office of Scientific Research under AF 49(638)640], Defence Research Board of Canada, National Research Council, and Office of Naval Research under Nonr-289500) Unclassified

Published in Canad. Jour. Phys., v. 38: 217-230, Feb. 1960.

A simple formula, based originally on the work of Klein and Rees, is developed for calculating potential energy curves, except near the dissociation limit, for electronic states of diatomic molecules. Classical turning points $r_{1,2}$ are given as functions of vibrational quantum number (V = v + 1/2), with coefficients depending on observed spectroscopic constants, in the form $\frac{r_{1,2}(V)}{r_e} = \left[\frac{S_1}{S_1 + S_2} + \left(\frac{f}{r_e}\right)^2\right]^{1/2} \pm \frac{f}{r_e}$ where $S_1(V) = 1 + \sum_{n=1}^{\infty} b_n V^n$; $S_2(V) \sum_{n=1}^{\infty} d_n V^n$; $\frac{f}{r_e} = 2\left(\frac{B_e}{\omega_e}\right)^{1/2} V^{1/2} S$; (V). For most states convergence is rapid, but as a rule more so for heavy molecules than for light molecules. Assuming it to be close to the "true" potential, such a representation affords a convenient means of assessing the accuracy of the Morse or other empirical potential function. Morse curves have also been fitted by least squares to Klein-Rees turning points. Term-by-term comparison between the inverted Dunham series and an equivalent form of the above has led to the discovery that if Dunham's small correction terms are neglected, Klein and Dunham potentials are mathematically identical. This is contrary to the generally held belief that the 2 should be used in mutually exclusive regions. In the present form these series exhibit better behavior over a wider range than a series giving potential energy as a function of internuclear separation. (Contractor's abstract)

2948

Western Ontario U. Dept. of Physics, London (Canada).

A SIMPLE APPARATUS FOR MAKING 10- TO 100-μ SPHERES OF LOW MELTING POINT METALS, by H. Van der Laan and R. W. Nicholls. [1959] [1]p. incl. diagr. (Sponsored jointly by Air Force Cambridge Research Center, [Air Force Office of Scientific Research under AF 49(638)640], Defence Research Board of Canada, Department of Defence Production of Canada, National Research Council of Canada, and Office of Naval Research) Unclassified

Published in Rev. Scient. Instr., v. 31: 212, Feb. 1960.

A description is given of a spray shot tower, which was constructed in connection with studies on ablation of shock-excited metal powders. It consists of a small

cylindrical steel reservoir into which the metal to be dispersed into spherical droplets is placed and heated by torches until liquified, a path for the liquid metal to reach the nozzle, a bypass for the carrier gas (nitrogen), and a free-fall region of about 6 ft onto a glass plate. The apparatus is considered suitable for making spheres of metals whose melting points lie below 400°C.

2949

Western Ontario U. Dept. of Physics, London (Canada).

VIBRATIONAL TRANSITION PROBABILITIES OF DIATOMIC MOLECULES: COLLECTED RESULTS. IV. BeO, BO, CH^+, CO, NO, SH, O_2, O_2^+, by R. W. Nicholls, P. A. Fraser and others. [1959] [8]p. incl. tables, refs. (Sponsored jointly by Air Force Cambridge Research Center under AF 19(604)4560, [Air Force Office of Scientific Research under AF 49(638)-640], Defence Research Board of Canada, Department of Defence Production of Canada, National Research Council of Canada, Office of Naval Research under Nonr-289500, and Ontario Research Foundation) Unclassified

Published in Astrophys. Jour., v. 131: 399-406, Mar. 1960.

Arrays of approximate vibrational transition probabilities (i.e., overlap integral squares or Franck-Condon factors) are presented for the following molecular transitions: BeO: $B^1\Sigma^+ \rightarrow X^1\Sigma^+$; $B^{11}O^{16}$ and $B^{10}O^{16}$: $A^2\Pi_i \rightarrow X^2\Sigma^+$ (α-system); CH^+: $A^1\Pi \rightarrow X^1\Sigma^+$; CO: $B^1\Sigma^+ \rightarrow A^1\Pi$ (angstrom bands) and $b^3\Sigma^+ \rightarrow a^3\Pi_r$ (third positive); NO: $B^2\Pi \rightarrow X^2\Pi$ (β-system); SH and SD: $A^2\Sigma \rightarrow X^2\Pi$; O_2: $a^1\Delta_g \rightarrow X^3\Sigma_g$ (infrared atmospheric bands); and O_2^+: $A^2\Pi_u \rightarrow X^2\Pi_g$ (second negative). (Contractor's abstract)

2950

Western Ontario U. Dept. of Physics, London (Canada).

INTENSITY MEASUREMENTS ON THE CO^+ COMET TAIL AND BO α AND β MOLECULAR BAND SYSTEMS, by D. Robinson and R. W. Nicholls. [1959] [9]p. incl. tables, refs. (Sponsored jointly by Air Force Cambridge Research Center, [Air Force Office of Scientific Research under AF 49(638)640], Defence Research Board of Canada, Department of Defence Production of Canada, and National Research Council of Canada) Unclassified

Published in Proc. Phys. Soc. (London), v. 75: 817-825, June 1, 1960.

Relative band intensities of the comet tail system ($A^2\Pi$-$X^2\Sigma$) of CO^+ and of the $\alpha(A^2\Pi$-$x^2\Sigma)$ and $\beta(B^2\Sigma$-$x^2\Sigma)$ systems of BO have been measured photoelectrically. They have been interpreted with the aid of Franck-Condon factors $q_{v'v''}$ and r-centroids $\bar{r}_{v'v''}$ to show the variation of electronic transition moment ($R_e(r)$ with internuclear separation r and thereby to give "smoothed" arrays of relative vibrational transition probabilities $p_{v'v''}$ and intensities at infinite temperature I_∞. The isotope effect on the Franck-Condon factors and intensities in the case of BO^{10} and BO^{11} band systems has been examined. (Contractor's abstract)

2951

Western Ontario U. Dept. of Physics, London (Canada).

THE SPECTROSCOPY OF IONIC COLLISIONS. I. THE DESIGN OF A SIMPLE 100 KV PROTON ACCELERATOR, by E. M. Reeves. June 1, 1960 [32]p. incl. illus. diagrs. (GRD-TN-60-497) (AFOSR-TN-60-484) (Sponsored jointly by Air Force Cambridge Research Center as scientific rept. no. 4 under AF 19(604)4560; Air Force Office of Scientific Research as scientific rept. no. 1 under AF 49(638)640; Canadian Armament Research and Development Establishment; Department of Defence Production of Canada; Office of Naval Research as scientific rept. no. 1 under Nonr-289500; Ontario Cancer Treatment and Research Foundation; and Ontario Research Foundation) AD 247898 Unclassified

In order to study the luminosity arising from collisions between positive ion beams and atomic or molecular gas targets over the energy range from 30 to 100 kv, a proton accelerator was constructed. The accelerator employs an Oak Ridge type ion source with an electrostatic focusing system and magnetic mass analyzer to produce a proton ion beam. The technical details of design, construction, and operation of the accelerator are considered and also the operating conditions under which preliminary observations on the spectra resulting from the ionic collisions were carried out. (Contractor's abstract)

2952

Western Ontario U. Dept. of Physics, London (Canada).

ON THE NATURE OF ULTRA-VIOLET LIGHT WHICH ACCOMPANIES THE DECOMPOSITION OF SOME AZIDES, by R. W. Nicholls. [1960] 7p. incl. table, refs. (AFOSR-TN-60-494) (Sponsored jointly by Air Force Cambridge Research Center, Air Force Office of Scientific Research under AF 49(638)640, Department of Defence Production of Canada, and Office of Naval Research) Unclassified

Also published in Jour. Phys. Chem., v. 64: 1760-1762, Nov. 1960.

Audubert and his colleagues have reported that a very feeble luminosity accompanies the slow thermal decomposition of NaN_3, KN_3, AgN_3, $Pb(N_3)_2$, $Ca(N_3)_2$, $Ba(N_3)_2$, TlN_3. It also occurs near the anode during

electrolysis of NaN_3 and HN_3. The purpose of the note is to suggest that the broad features noted probably arise from groups of bands of the N_2 Vegard-Kaplan ($A^3\Sigma_u^+ \rightarrow X^1\Sigma_g^+$) system which originates from the $v^1 = 0, 1, 2, 3$ levels of the $A^3\Sigma_u^+$ state. It is considered physically more reasonable to attribute all of the bands to one system than to rely on individual wavelength coincidences between the bands and those of difference N_2 systems.

2953

Western Ontario U. Dept. of Physics, London (Canada).

TRANSITION PROBABILITIES OF MOLECULAR BAND SYSTEMS. XVII. TABULATED KLEIN-DUNHAM POTENTIAL ENERGY FUNCTIONS FOR FIFTEEN STATES OF N_2, N_2^+, NO, O_2, C_2 AND OH, by W. R. Jarmain. July 1, 1960, 17p. incl. diagrs. tables. (GRD-TN-60-498) (AFOSR-TN-60-877) (Sponsored jointly by Air Force Cambridge Research Center as scientific rept. no. 5 under AF 19(604)4560, Air Force Office of Scientific Research as scientific rept. no. 2 under AF 49(638)640, and Office of Naval Research as scientific rept. no. 2 under Nonr-289500) AD 247906; PB 153637 Unclassified

Sets of classical turning points, together with the corresponding vibrational energies, are given for the following molecular states: N_2, $X^1\Sigma_g^+$, $a^1\pi_g$, $A^3\Sigma_u^+$, $B^3\pi_g$, $C^3\pi_u$; N_2^+, $A^2\pi$; NO, $A^2\Sigma^+$, $B^2\pi_r$; O_2, $a^1\Delta_g$, $b^1\Sigma_g^+$, C_2, $X^3\pi_u$, $a^1\Sigma_g^+$, $b^1\pi_u$, $d^1\Sigma_u^+$; OH, $X^2\pi_i$. These numbers, which were calculated from series formulae, represent Klein-Dunham potential energy functions for the states listed. The maximum vibrational quantum number varies from 2 to 14, depending on available experimental data. (Contractor's abstract)

2954

Western Ontario U. Dept. of Physics, London (Canada).

d-WAVE CONTRIBUTION TO ELECTRON HYDROGEN ATOM SCATTERING, by R. P. McEachran and P. A. Fraser. [1959] [4]p. incl. diagr. table, refs. (AFOSR-J109) (Sponsored jointly by Air Force Cambridge Research Center, [Air Force Office of Scientific Research under AF 49(638)640], Department of Defence Production of Canada, National Research Council of Canada, and Ontario Research Foundation) AD 400184 Unclassified

Also published in Canad. Jour. Phys., v. 38: 317-320, Feb. 1960.

Results are reported on calculation of d-wave phase shifts and corresponding scattering cross sections for the elastic scattering of low-energy electrons by hydrogen atoms. It was found that d-wave phase shifts are quite small at low energies in comparison with the corresponding values for s- and p-waves. Within the exchange approximation and up to electron energies of 13.6 ev, the inclusion of the d-wave partial scattering cross section affects the total elastic cross section by at most 1%, and therefore does not account for the discrepancy between the theoretical and experimental measurements of Bederson et al (New York U. Electron Scattering Project, 1958).

2955

Western Ontario U. Dept. of Physics, London (Canada).

FRANCK-CONDON FACTORS AND r-CENTROIDS FOR SOME BANDS OF THE CO FOURTH POSITIVE ($A^1\Pi$-$X^1\Sigma$) BAND SYSTEM, by W. R. Jarmain, R. Ebisuzaki, and R. W. Nicholls. [1959] [3]p. incl. table, refs. (AFOSR-J112) (Sponsored jointly by Air Force Cambridge Research Center, Air Force Office of Scientific Research under [AF 49(638)640], Defence Research Board of Canada, Department of Defence Production of Canada, National Research Council of Canada, and Office of Naval Research) AD 400441 Unclassified

Also published in Canad. Jour. Phys., v. 38: 510-512, Mar. 1960.

The array for the CO fourth band-system is presented together with band-head wavelengths and r-centroids.

2956

Western Ontario U. Dept. of Physics, London (Canada).

MEASUREMENTS OF ROTATIONAL ENERGY DISTRIBUTIONS IN IONIC COLLISIONS, by E. M. Reeves and R. W. Nicholls. [1960] [6]p. incl. diagrs. refs. (AFOSR-J114) (Sponsored jointly by Air Force Cambridge Research Center, Air Force Office of Scientific Research under [AF 49(638)640], Defence Research Board of Canada, National Research Council of Canada, Office of Naval Research, and Ontario Research Foundation) AD 400055 Unclassified

Also published in Proc. Phys. Soc. (London), v. 78: 588-593, Oct. 1961.

The measured rotational intensity distribution of N_2^+ first negative bands excited by 1 mev protons indicates that the rotation of the molecules is not greatly affected by the collisions. Measured rotational temperatures compare favorably with laboratory temperatures. Similar observations on N_2^+ bands excited by 1 to 3 kev Li^+ ions show that these collisions appear to cause a marked departure from Boltzmann distribution of rotational energies. Energy levels of high and of low quantum numbers are enhanced in population. (Contractor's abstract)

2957

Western Ontario U. Dept. of Physics, London (Canada).

OPTICAL EXCITATION OF N_2 BY 0.5 TO 1.5 MEV HYDROGENIC IONS, by E. M. Reeves, R. W. Nicholls,

and D. A. Bromley. [1960] [6]p. incl. diagrs. tables. (AFOSR-J115) (Sponsored jointly by Air Force Cambridge Research Center, Air Force Office of Scientific Research under [AF 49(638)640], National Research Council of Canada, Office of Naval Research, and Ontario Research Foundation) AD 400056
Unclassified

Also published in Proc. Phys. Soc. (London), v. 76: 217-222, Aug. 1, 1960.

Spectroscopic studies have been made of the luminosities produced by 0.5 to 1.5 mev beams of H^+, HH^+, and HHH^+ in N_2 at pressures below 100μ Hg. Photography and identification of spectra, measurement of the variation of intensities of spectral features with pressure, and spectroscopic temperature measurements confirm a primary mechanism of single collision ionization with excitation. Effects of secondary excitation processes by secondary electrons produced in the primary processes are discussed. (Contractor's abstract)

2958

Western Ontario U. Dept. of Physics, London (Canada).

AN f/6 LITTROW GRATING SPECTROGRAPH, by J. P. Fallona, H. I. S. Ferguson, and W. R. Nicholls. [1959] [3]p. incl. illus. diagr. refs. (AFOSR-J118) [AF 49(638)640] AD 400196 Unclassified

Presented at meeting of the Opt. Soc. Amer., Ottawa (Canada), Oct. 8-10, 1959.

Also published in Jour. Opt. Soc. Amer., v. 51: 353-355, Mar. 1961.

An inexpensive f/6 Littrow spectrograph has been constructed from a plane grating and aerial camera lens. It has a free spectral range of 4000-7000A on 9 in. of 35-mm film, a reciprocal dispersion of 13 A/mm, and a resolving power (at 5200A) of 5200. (Contractor's abstract)

2959

[Western Ontario U. Dept. of Physics, London (Canada)]

THE FRANCK-CONDON FACTOR ($q_{v'v''}$) ARRAY TO HIGH VIBRATIONAL QUANTUM NUMBERS FOR THE $O_2(B^3\Sigma_u^- - X^3\Sigma_g^+)$ SCHUMANN-RUNGE BAND SYSTEM, by R. W. Nicholls. [1960] [7]p. incl. tables, refs. (AFOSR-J519) [AF 49(638)640] AD 414440
Unclassified

Also published in Canad. Jour. Phys., v. 38: 1705-1711, Dec. 1960.

A Franck-Condon factor $q_{v'v''}(|\int\psi_{v'}\psi_{v''}dr|^2)$ array was computed for a Morse model by direct numerical integration over the range of quantum numbers $0 < v' < 21$; $0 < v'' < 21$.

2960

[Western Ontario U. Dept. of Physics, London (Canada).

SPECTROSCOPIC APPLICATIONS OF PHOTOGRAPHIC EMULSION MOSAICS, by R. W. Nicholls. [1960] [1]p. incl. diagr. [AF 49(638)640] Unclassified

Published in Nature, v. 186: 715, May 28, 1960.

The availability of Kodak O to Z emulsions enables a spectroscopic survey to be made by a sequence of separate exposures of different emulsions, each selected on the basis of wave-length range of maximum sensitivity. Furthermore, Kodak emulsions on films make it possible to assemble mosaics made up of 2 or more segments of different emulsions, each easily cut to a length specific to the wave-length range of its maximum sensitivity. The gain in sensitivity obtained by the use of an optimum emulsion mosaic in place of a single emulsion is shown graphically. The practicability of using emulsion mosaics was tested by using segments of 103-aO, 103-aF, and 1-N 16 mm film in conjunction with Hilger medium quartz and medium glass spectrographs. A relatively uniformly exposed spectrum was obtained in each case on the mosaic as expected.

2961

[Western Ontario U. Dept. of Physics, London (Canada)]

INTERPRETATION OF INTENSITY DISTRIBUTIONS IN THE N_2 LYMAN-BIRGE-HOPFIELD AND CO FOURTH POSITIVE BAND SYSTEMS, by R. W. Nicholls. [1960] [2]p. [AF 49(638)640] Unclassified

Published in Nature, v. 186: 958-959, June 18, 1960.

Analysis of eye estimates of intensities of bands of the 2 systems leads to the belief that the electronic transition moment of each system may be substantially independent of internuclear separation. Thus Franck-Condon factors are probably a good quantitative measure of relative vibrational transition probabilities in each case.

2962

Western Ontario U. Dept. of Physics, London (Canada).

SPECTROSCOPIC TEMPERATURE MEASUREMENTS IN A SHOCK TUBE USING CN AS A THERMOMETRIC MOLECULE, by W. H. Parkinson and R. W. Nicholls. [1960] [5]p. incl. diagr. table, refs. [AF 49(638)640] Unclassified

Published in Canad. Jour. Phys., v. 38: 715-719, June 1960.

Rotational intensity measurements on the CN spectrum, excited through shock excitation of a powdered mixture of NH_4Cl, KNO_2, and C by helium-driven shock waves in argon have been used to infer "rotational

temperatures" of the gas between 6350° and 8750°K. The measured values agree well with gas kinetic temperatures calculated from simple gas dynamic theory and shock wave velocity measurements. (Contractor's abstract)

2963

Western Ontario U. Dept. of Physics, London (Canada).

SHOCK EXCITATION OF SOLID AROMATIC HYDROCARBONS, by R. W. Nicholls and M. D. Watson. [1960] [2]p. incl. table, refs. (Sponsored jointly by Air Force Cambridge Research Center, [Air Force Office of Scientific Research under AF 49(638)640], Defence Research Board of Canada, Department of Defence Production of Canada, National Research Council of Canada, and Ontario Research Foundation) Unclassified

Published in Nature, v. 188: 568-569, Nov. 12, 1960.

The variation with environmental temperature of the spectra from shock excitation of powdered benzene, naphthalene, and anthracene are discussed. Observations were made of benzene in the temperature range 4900-8,440°K, naphthalene, 3890-13,000°K, and anthracene, 3,630-12,020°K. In each case the main contributions to the spectra were the (0;0, 1, 2) (1;0, 1, 2, 3) (2;0, 1, 2, 3, 4) (3;1, 2, 3, 4, 5) (4;2, 3, 5, 6) (5;6) C_2 Swan bands, the (0;0, 1) (1;1, 2) (2;2, 3) (3;3, 4) (4, 5) (5, 6) CN violet bands (nitrogen was an impurity in the argon), the (0, 0) CH band (λ4315A), and (except in the case of benzene) a carbon particle continuum, the intensity and spectral range of which were extremely sensitive to temperature.

2964

Western Ontario U. Dept. of Physics, London (Canada).

INTENSITY MEASUREMENTS ON OVERLAPPED MOLECULAR BANDS, by D. Robinson and R. W. Nicholls. [1960] [12]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Cambridge Research Center, [Air Force Office of Scientific Research under AF 49-(638)640], Defence Research Board of Canada, Department of Defence Production of Canada, National Research Council of Canada, and Ontario Research Foundation) Unclassified

Published in Jour. Quant. Spectros. and Radiative Transfer, v. 1: 76-87, Sept. 1961.

The measurement of intensities of molecular band systems is often complicated by the partial overlapping of adjacent bands, making the direct measurement of integrated total band intensities extremely difficult. Two general methods are suggested here. In the first a known fraction of the band is employed, and in the second, the rotational intensity distribution within a band is interpreted in terms of the total band intensity. The methods have been tested experimentally and found to be in good agreement for the NO β and O_2^+ second negative systems where the integrated intensities were independently measured.

2965

Western Reserve U. Dept. of Physics, Cleveland, Ohio.

RECENT EXPERIMENTAL RESULTS ON ORBITAL ELECTRON CAPTURE, by B. L. Robinson and R. W. Fink. [1960] [12]p. incl. diagrs. tables, refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)61], Atomic Energy Commission and National Science Foundation) Unclassified

Published in Rev. Modern Phys., v. 32: 117-128, Jan. 1960.

Experimental techniques and results on electron-capture ratios, comparative half-lives and transition energies are summarized. Transition energies are computed from observed capture ratios for about twenty cases. Six experiments are precise enough to be compared critically with the theory of Brysk and Rose, and the observed L/K capture ratios are found to be some 10% higher than predicted. The discrepancies seem to be independent of atomic number for $18 \leq Z \leq 53$; it is not at all clear that the effect of correlations between the coordinates of the K electrons, suggested by Odiot and Daudel, is sufficient to account for the discrepancy. (Contractor's abstract)

2966

Western Reserve U. Dept. of Physics, Cleveland, Ohio.

NUCLEAR SHELL MODEL: HARTREE-FOCK APROXIMATION WITH GAMMEL-THALER TWO-NUCLEON POTENTIAL, by G. E. Tauber and T.-Y. Wu. [1960] [23]p. incl. tables, refs. (AF 18(603)61) Unclassified

Published in Nuclear Phys., v. 16: 545-567, June 1960.

To investigate how good or bad the Hartree-Fock approximation is for the atomic nuclei, a calculation has been carried out with the phenomenological 2-nucleon potential $V(r_i - r_j)$ of Gammel-Thaler containing a repulsive core, a central, a tensor and an $L \cdot S$ interaction. Harmonic oscillator wave functions are used for the 1-nucleon wave functions. The parameters in the wave functions and a multiplicative parameter in $V(r_i - r_j)$ are determined from O^{16} by the variational principle and the empirical total energy. These (now fixed) parameters are then used to calculate the energy of the configuration $(1s)_\nu^2 (1p)_\nu^5 (1s)_\pi^2 (1p)_\pi^6$ of O^{15}. It is found that the $L \cdot S$ term in $V(r_i - r_j)$ gives rise to a doublet $E(J = 3/2 - E(J = 1/2) = + 31.6$ mev. The total binding energy is $E(J = 1/2) = - 114.8$ mev compared with the empirical value - 111.97 mev. The sign of this doublet corresponds, on the picture to the individual nucleon moving in an effective central field and posessing an $l_i \cdot s_i$ interaction, to a sign $l_i \cdot s_i$ opposite to that of the electron, and is in agreement with the fundamental hypothesis of the nuclear shell model of Mayer and of Jensen et al. The magnitude of the doublet, however, is too large, by a factor of about 5. These results are discussed. (Contractor's abstract)

2967

[Western Reserve U. School of Library Science, Cleveland, Ohio]

INTRODUCTION TO ENGINEERING OF SEARCHING SYSTEMS, by J. W. Perry and A. Kent. [1958] [16]p. [AF 49(638)357] Unclassified

Published in Library Sci. and Doc., v. 1: 33-48, 1958.

The scope of many questions that are asked of information-finding systems are conditioned by the questioner's understanding of the framework and limitations of the system being approached. Therefore, designers of new systems cannot, with confidence, use present habits of any level of user as a criterion for guidance in new systems. The manner in which coding operations are performed determines the degree of success achieved by applying various mechanical and electronic devices to selecting and correlating information. Although the recording operations of nonconventional systems, employing either manual or automatic devices, are essentially binary in character, there still remains the necessity for devoting care to the assignment and meaning of binary recordings. Recent trends toward the application of automation techniques in information retrieval have led to a series of problems, the solutions of which necessitate a balancing and coordinating of the design parameters of the system.

2968

[Western Reserve U. School of Library Science, Cleveland, Ohio]

A NOTE ON THE COMPATIBILITY OF TWO INFORMATION SYSTEMS, COLON CLASSIFICATION AND WESTERN RESERVE UNIVERSITY (ENCODED TELEGRAPHIC ABSTRACTS) AND THE FEASIBILITY OF INTERCHANGING THEIR NOTATIONS, by J. S. Melton. [1960] [14]p. incl. tables. (AFOSR-TN-60-261) (AF 49(638)357) Unclassified

Also published in Ranganathan Festchrift, v. 1: 49-62, 1965.

The similarity between the aims and accomplishments of the Colon Classification of S. R. Ranganathan and the Encoded Telegraphic Abstracts of J. W. Perry et al of Western Reserve U. has been noted by many documentalists. A comparison of the two systems indicates that each (1) overcomes the rigidity of conventional hierarchical classification, (2) allows for the recording of any number and kinds of facets which may characterize a piece of literature, as well as for their interactions, (3) extends "infinite hospitality" to new and yet undiscovered facets, and (4) stresses the importance of first characterizing on the idea plane rather than on the verbal plane. Due to the high degree of compatibility existing between the two systems it is concluded that the notations used by the Colon Classification could be mechanically converted to the notation system used by Western Reserve U.

2969

Western Reserve U. School of Library Science, Cleveland, Ohio.

MATHEMATICAL FORMULATION OF BASIC PROCEDURES IN DOCUMENTATION, by J. W. Perry and W. Goffman. Apr. 13, 1960, 50p. (AFOSR-TN-60-366) (AF 49(638)357) AD 429098 Unclassified

Presented at Center for Documentation and Communication Research Conf. on Theory of Documentation and Searching Strategy, Western Reserve U., Cleveland, Ohio, Apr. 12-13, 1960.

Certain basic aspects of documentation, especially the relationship of a "message" to alternate means for its expression and recording were studied. Attention was also directed to various documentation processes in which the message remains invariant, though the symbolism for expressing it may be greatly altered. In considering mathematical formulation, this led to such concepts as the message as a set, which may find expression in an equivalence class of sets, each of which is a version of a given message. The concept of set, in turn, led us to such concepts as sets of sets, subsets, and irreducible sub-sets-also sometimes called "unit elements". The concepts of mapping and inverse mapping were also shown to be directly involved when dealing with such equivalence classes. These concepts are of essential importance for considering in a uniform and rigorous manner a very wide range of documentation processes ranging from translating from one natural language to another to alphabetical indexing, encoding for machine searching, and abstracting, performed either by people or by programmed machines. (Contractor's abstract)

2970

Western Reserve U. [School of Library Science] Cleveland, Ohio.

AN APPLICATION OF GENERIC-SPECIFIC CONTENT ANALYSIS TO SEARCHING PROCEDURE (Abstract), by J. L. Melton. [1960] [1]p. (AF 49(638)357) Unclassified

Presented at Center for Documentation and Communication Research Conf. on Theory of Documentation and Searching Strategy, Western Reserve U., Cleveland, Ohio, Apr. 12-13, 1960

The major problem in any searching procedure is the phrasing of the search requirement, or question, in such a way as to produce the desired information with the greatest efficiency. A method is described which provides certain objective criteria on one aspect of questions; their generic and specific content. Such criteria may be used for the determination of which of a number of possible phrasings is likely to be most effective in a given search.

2971

Western Reserve U. [School of Library Science] Cleveland, Ohio.

CONVERSION OF THE CHEMICAL ABSTRACTS SUBJECT INDEX FOR MACHINE SEARCHING (Abstract), by J. S. Melton. [1960] [1]p. (AF 49(638)357) Unclassified

Presented at Center for Documentation and Communication Research Conf. on Theory of Documentation and Searching Strategy, Western Reserve U., Cleveland, Ohio, Apr. 12-13, 1960.

Two problems involved in the preparation and utilization of an encoded file of the subject index to Chemical Abstracts for machine searching are considered. The first problem arises from the relationship of the page format of Chemical Abstracts to the subject index references to individual abstracts. The page format dictates a reference system based on the location of the information indexed on a page. This system presents certain difficulties for converting the index to tape and for its later exploitation in a machine search. Automatically assigned grouping possibilities are described and the effect of each on searching efficiency is discussed. The time and cost involved in an adjustment of overlapping references is estimated. The second problem considered is the duplication of terminology of the printed subject index, and the possibility of automatically eliminating duplicate words where duplication was necessitated by the alphabetical arrangement of entries in the printed index. Various degrees of word duplication in the index entries are described, from total duplication, i.e., alphabetical permutations, to incidental duplication of a single term where the subject content of two entries has a single common aspect. The effect on search efficiency of the elimination of duplication is discussed. The relative length of the tape with and without duplication is estimated.

2972

Western Reserve U. [School of Library Science] Cleveland, Ohio.

A LOGICAL APPROACH TO THE ANALYSIS OF QUESTIONS FOR GENERIC AND SPECIFIC CONTENT (Abstract), by J. W. Perry and J. H. Kennedy. [1960] [1]p. (AF 49(638)357) Unclassified

Presented at Center for Documentation and Communication Research Conf. on Theory of Documentation and Searching Strategy, Western Reserve U., Cleveland, Ohio, Apr. 12-13, 1960.

Different systems for characterizing documents, especially alphabetized indexes, classification systems, and encoded abstracts, are known to vary widely, especially with regard to their capabilities as aids for providing answers to different kinds of questions at minimum cost. The definition and evaluation of such differences in capabilities of systems, on the one hand, and the scope of different kinds of questions, on the other hand, are important both in designing and in exploiting documentation systems. This general problem may be approached by applying the boolean algebra, as is illustrated by the development of general formulations and by their application to specific cases.

2973

Western Reserve U. [School of Library Science] Cleveland, Ohio.

RELIABILITY DISTRIBUTIONS OF DOCUMENTATION SYSTEMS (Abstract), by H. M. Wadsworth and R. E. Booth. [1960] [1]p. (AF 49(638)357) Unclassified

Presented at Center for Documentation and Communication Research Conf. on Theory of Documentation and Searching Strategy, Western Reserve U., Cleveland, Ohio, Apr. 12-13, 1960.

An analysis of the reliability of a documentation system concerns the probability that all of the operations of the system will function in a prescribed manner with a specified frequency of error. There is a notable similarity between the reliability of the processes of documentation systems and the reliability of components of electronic systems. The latter is currently receiving a great deal of attention by many statisticians as a result of the advent of complex electronic systems such as those found in modern aircraft and guided missiles. A documentation system is described as being made up of processes; processes are made up of jobs; and in turn, jobs are made up of operations. A stochastic reliability function has been developed wherein the random variable is time between error in performance at the operation level. Time here refers to the number of operations performed. Procedures for the empirical evaluation of the reliability of any documentation system, process, job, or operation have been developed and described in some detail.

2974

Western Reserve U. [School of Library Science] Cleveland, Ohio.

RESEARCH STRATEGY IN DOCUMENTATION (Abstract), by J. W. Perry. [1960] [1]p. (AF 49(638)357) Unclassified

Presented at Center for Documentation and Communication Research Conf. on Theory of Documentation and Searching Strategy, Western Reserve U., Cleveland, Ohio, Apr. 12-13, 1960.

The formulation of strategy in library automation requires due regard for the relationship between library operations and other activities involved in the generation and utilization of knowledge. Studies of this relationship suggest that to attain optimum operational results, fundamental thinking must be bold and imaginative, considering what has been done previously and considering also what can be made possible in the future. Tentative methods and prototypes must be tested experimentally, and mathematical concepts appear to be extremely useful

here. The results of such tests must be submitted to critical, objective evaluation, and redefinition of methods must be carried out without giving way to the temptation prematurely to standardize tentative procedures.

2975

Western Reserve U. School of Medicine, Cleveland, Ohio.

SPINAL CORD AND ADRENOCORTICOTROPIN RELEASE, by E. S. Redgate. [1960] [4]p. incl. tables. (AFOSR-TN-60-1126) [AF 49(638)443] AD 254097 Unclassified

Also published in Proc. Soc. Exper. Biol. and Med., v. 105: 528-531, 1960.

Spinal cord section results in early adrenal ascorbic acid depletion. Recovery of normal levels occurs after 48 hrs and is maintained for at least one week. Cord-sectioned rats (2- or 7-day), exhibiting normal initial adrenal ascorbic acid levels, respond to injected ACTH with ascorbic acid depletion similar to that observed in 24-hr hypophysectomized rats. Adrenal ascorbic acid depletion response was employed as an index of blood ACTH levels. Intact rats respond to electric current flow through either forepaws or hindpaws with equivalent ACTH release. Cord-sectioned rats respond to forepaw stimulation with ACTH release, but do not respond to hindpaw stimulation. Sham stimulation of intact or cord-sectioned rats does not release ACTH. (Contractor's abstract)

2976

Western Reserve U. School of Medicine, Cleveland, Ohio.

VASOPRESSIN IN BLOOD: EFFECT OF HEMORRHAGE, by H. Weinstein, R. M. Berne and H. Sachs. [1960] [7]p. incl. diagr. tables, refs. (AFOSR-TN-60-1101) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)764 and National Institutes of Health) AD 244499 Unclassified

Also published in Endocrinology, v. 66: 712-718, May 1960.

A method was developed for the estimation of vasopressin in blood. By means of a few simple chemical and chromatographic procedures, vasopressin contained in large quantities of blood may be extracted and obtained in small volumes of solution suitable for either bioassay determinations or further purification. These methods coupled with a bioassay procedure were employed for the study of the time course of changes in the concentration of pressor material in the blood after hemorrhage. Evidence is presented that this pressor material is identical with vasopressin. From the results of these studies, an approximate rate and total discharge of vasopressin into blood of dogs subjected to hemorrhage was calculated. (Contractor's abstract)

2977

Western Reserve U. School of Medicine, Cleveland, Ohio.

STUDIES CONCERNED WITH VASOPRESSIN BIOSYNTHESIS, by H. Sachs. [1960] [21]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1102) [AF 49(638)764] Unclassified

Also published in Regional Neurochemistry; Proc. of Fourth Internat'l. Neurochemical Symposium, Varenna (Italy) (June 12-19, 1960), New York, Pergamon Press, 1961, p. 264-273.

Approaches to the study of certain aspects of the biosynthesis of a well-known neurosecretory substance, vasopressin (or the anti-diuretic hormone) are described. Vasopressin was chosen because of its distinguishing chemical, chromatographic and biological properties. Problems encountered in the study of vasopressin biosynthesis include the fact that the vasopressin must be isolated isotopically pure in an experimental animals' hypothalamo-neurohypophysial complex, the slow rate of synthesis and the difficulty of locating the position for synthesis of the hormone are only a couple of the problems encountered. The resolution of some of the difficulties found is discussed by the author and it is pointed out that these advances now make it possible to study the biosynthesis, storage and release of vasopressin.

2978

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

A HIGH REGULATION ION GAUGE POWER SUPPLY, by J. S. Knoll. May 25, 1960 [6]p. incl. illus. diagr. tables. (Research rept. no. 403FD428-R4) (AFOSR-TN-60-573) (AF 49(638)591) Unclassified

A dc filament, emission regulator for the Bayard-Alpert ion gauge is described, giving specifications, circuit diagram and normal and outgas operations. The minute changes in ion current (the order of .1%) are monitored by a fast response, recording galvanometer (up to 500 cps), which regulates the electron emission current against system pressure changes, and powers the filament with highly regulated and filtered dc. This is done in order not to induce spurious ac signal at the ion collector which would mask the small ion current changes.

2979

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

ELECTRICAL CLEANUP OF GASES, by R. E. Fox and J. S. Knoll. Final rept. Mar. 15, 1959-May 14, 1960 [26]p. incl. illus. diagrs. tables. (Research rept. no. 403FD428-R5) (AFOSR-TR-60-72) (AF 49(638)591) AD 238272 Unclassified

The short term re-emission studies have been extended down to times approaching 1 sec. These studies indicate that even at these short times, re-emission follows a

1/T dependence. Further studies are needed with a modified tube to carry the times to shorter intervals. Temperature dependence of the re-emission rate, as well as the pumpdown rate has been carried out over a temperature range from room temperature down to liquid nitrogen (-200°C) temperature. This effect is significant and should be accurately controlled for re-emission studies. The studies of the dependence of ion energies on the re-emission rate were inconclusive due to the nature of the tube construction. The results indicate that the effect of ion pumping at the filament and/or its supports is more important for a tube of this geometry than had previously been suspected. (Contractor's abstract)

2980

Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

PROPAGATION MECHANISM OF GERMANIUM DENDRITES, by D. R. Hamilton and R. G. Seidensticker. [1960] [4]p. incl. diagrs. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)599] and Wright Air Development Center) Unclassified

Published in Jour. Appl. Phys., v. 31: 1165-1168, July 1960.

The role of the twin planes in the rapid dendritic propagation of Ge crystals is examined on the basis of corner nucleation. A model is proposed, and it is shown that at least 2 twin planes must be present for continued easy propagation in <211> directions, in good agreement with experimental observations. The absence of the dendrite with only 1 twin is explained. (Contractor's abstract)

2981

Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.

GROWTH OF ATOMICALLY FLAT SURFACES ON GERMANIUM DENDRITES, by R. L. Longini, A. I. Bennett, and W. J. Smith. [1960] [4]p. incl. diagrs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)599] and Wright Air Development Center) Unclassified

Published in Jour. Appl. Phys., v. 31: 1204-1207, July 1960.

This note presents a theory of the formation of extended flat surfaces on Ge dendrites. It is suggested that part of the liquid-solid interface is a supercooled {111} surface, on which new atomic planes are occasionally nucleated. Thermal limitations on the nucleation and propagation of these monolayers are discussed. When such a growing layer reaches the melt surface it creates a step on the solid. It is proposed that the meniscus momentarily sticks to the corner of this step. Subsequent planes nucleated during this sticking period result in a step several atomic layers high, in accord with experiment. Elementary estimates of corner energy and amount of meniscus sticking yield results consistent with experiment. (Contractor's abstract)

2982

Wisconsin U. Dept. of Bacteriology, Madison.

THE CONTROL OF ENZYME BIOSYNTHESIS IN YEAST, by H. O. Halvorson. [1960] [8]p. incl. diagrs. tables, refs. (AFOSR-TN-60-731) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)-314 and National Institutes of Health under E1459) AD 243808 Unclassified

Also published in Wallerstein Labs. Commun., v. 23: 5-12, Apr. 1960.

A discussion is presented of present knowledge concerning the nature and mechanism of control of specific enzyme biosynthesis in yeast. Yeasts contain a large reservoir of free amino acids which can be drawn upon for protein synthesis. When they are incubated in a nitrogen-free medium, intracellular breakdown of protein and nucleic acid occurs which serves to replace the supply of precursor materials for enzyme synthesis. Protein and induced enzyme synthesis continue until the supply of labile reserves is depleted. The increasing number of enzymes that can be specifically regulated lead to the prediction that any of the enzymes of the cell can be uniquely varied by induction or repression. The data indicate that although the methods required to control any one enzyme may vary, the main feature of the control mechanisms demonstrated thus far is their similarities rather than their differences. Under appropriate conditions the enzymatic pattern of the cell can be controlled for a specific purpose — either by suppressing a given activity or by selective induction.

2983

Wisconsin U. Dept. of Bacteriology, Madison.

YEAST β-GLUCOSIDASE: COMPARISON OF THE PHYSICAL-CHEMICAL PROPERTIES OF PURIFIED CONSTITUTIVE AND INDUCIBLE ENZYME, by A. S. L. Hu, R. Epstein and others. [1960] [9]p. incl. illus. diagrs. tables, refs. (AFOSR-TN-60-732) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)314] and National Institutes of Health under E1459) AD 255561 Unclassified

Also published in Arch. Biochem. and Biophys., v. 91: 210-218, Dec. 1960.

A constitutive β-glucosidase has been purified about 200-fold from the yeast hydrid Saccharomyces dobzhanskii X Saccharomyces fragilis. The purified enzyme was homogeneous to electrophoresis and ultracentrifugation. The physical-chemical properties of the enzyme are described and compared with those of an inducible β-glucosidase of Rhodotorula minute. The 2 enzymes were indistinguishable with the exception of their behavior toward natural β-glucosides. The affinity constants of these β-glucosides were ten times higher for the constitutive enzyme than for the inducible enzyme. At

saturating substrate concentrations, the rates of hydrolysis were the same for both enzymes. The data suggest that the 2 enzymes differ in the nature of a group(s) in close proximity to the catalytic site. (Contractor's abstract)

2984

Wisconsin U. [Dept. of Bacteriology] Madison.

THE INDUCED SYNTHESIS OF PROTEINS, by H. O. Halvorson. [1960] [58]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1105) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)314 and National Institutes of Health under E-1459) Unclassified

Also published in Advances in Enzymol., v. 22: 99-156, 1960.

An attempt is made to focus attention on the biochemical mechanisms which are indicative in explaining the mechanism of the adaptive response. A model of the over-all phenomenon is presented as a guide for appraising the current knowledge of the process. It is shown that the problems of induced action can not be understood at the molecular level until a great deal more information is available on protein structure and the mechanism of protein synthesis. Questions that remain to be answered include: (1) Are induction and repression variations of the same fundamental regulatory mechanism? (2) Does a high molecular weight, stable precursor occur as an intermediate in enzyme synthesis, and does this pre-enzyme exist prior to the addition of the inducer? (3) Can a given polypeptide sequence give rise to more than 1 stable protein? (4) What is the cellular identity of the template?

2985

Wisconsin U. Dept. of Chemistry, Madison.

THE EFFECT OF SOLVENT ON SPECTRA. V. THE LOW INTENSITY ($n \rightarrow \pi^*$) ELECTRONIC TRANSITION OF CYCLIC KETONES, by E. M. Kosower and G.-S. Wu. [1960] [6]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1020) (AF 49(638)282) AD 243816 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3142-3147, July 20, 1961.

A series of cycloalkanones with ring size (n = 4-10, 15) has been examined in the near ultraviolet region in a series of solvents covering a broad polarity range and the transition energies (E_T) were plotted against the solvent polarity standard, Z. Cyclobutanone was found to have a $n \rightarrow \pi^*$ transition with rather low sensitivity to solvent. Examination of two other cyclobutanones suggested that such behavior may be characteristic of these rings. The transitions for the ketones with n = 5-10 correlate rather well with Z. The slope of the correlation for cyclopentadecanone (n = 15) was unexpectedly low which might indicate that the molecule tended toward folded conformations in polar solvents and towards open or extended configuration in non-polar solvents. The C_{15}-ketone absorption band obeyed Beer's law in all solvents.

2986

Wisconsin U. Dept. of Chemistry, Madison.

EFFECT OF SOLVENT ON SPECTRA. VI. DETECTION OF THE SOLVENT EFFECT ON MOLECULAR CONFORMATION OR SHAPE THROUGH Z-VALUES, by E. M. Kosower, G.-S. Wu, and T. S. Sorensen. [1960] [36]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1021) (AF 49(638)282) AD 244116 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3147-3154, July 20, 1961.

The effect of solvent on the position of the $n \rightarrow \pi^*$ transitions of various compounds has been studied. Although 2-fluorocyclohexanone correlates very well with Z (the solvent polarity standards), the data for the conformationally fixed 4-t-butyl derivatives indicate that a change in the position of a conformational equilibrium is occurring with a change in solvents. The same conclusion is reached for 2-chloro-cyclohexanone. Further data illustrating the rather good correlation between Z and electronic transistions of rigid cyclic ketones are given for cyclohexanone, isophorone, and 2,2-dimethyl-3,4-dihydro-[4H]-4-pyrone; in contrast, 3-acetyl-3-azabicyclo[4.4.0]-dec-5-en-4-one (II, H = $NCOCH_3$) apparently folds in non-polar solvents.

2987

Wisconsin U. Dept. of Chemistry, Madison.

THE EFFECT OF SOLVENT ON SPECTRA. VII. THE "METHYL EFFECT" IN THE SPECTRA OF DIHYDROPYRIDINES, by D. Hofmann, E. M. Kosower, and K. Wallenfels. [1960] [6]p. incl. illus. diagrs. tables, refs. (AFOSR-3136) (In cooperation with Freiburg U., Chemistry Lab., Breisgau (Germany)) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49-(638)282] and National Institutes of Allergy and Infectious Diseases under E-1608) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 3314-3319, Aug. 5, 1961.

The difference in ultraviolet maximum between 2,6-dimethyl-3,5-dicarbethoxy-1,4-dihydropyridine (λ_{max} 3690A) and 2,4,6-trimethyl-3,5-dicarbethoxy-1,4-dihydropyridine (λ_{max} 3490A) is explained as a result of the relative increase in non-bonded repulsion between the carbethoxy group and the 4-methyl group in the excited state as compared with the compound lacking the 4-methyl group. This explanation is supported by the decrease in the effect when the carbethoxy groups are replaced by cyano groups in which the charge increment in the excited state is farther away from the 4-methyl group. The validity of the comparisons between the

carbethoxy and cyano-substituted dihydropyridines is established by the parallelism in solvent effects upon the observed transitions. (Contractor's abstract, modified)

2988

Wisconsin U. Dept. of Chemistry, Madison.

PYRIDINIUM COMPLEXES. II. THE NATURE OF THE INTERMEDIATE IN THE DITHIONITE REDUCTION OF DIPHOSPHOPYRIDINE NUCLEOTIDE DPN, by E. M. Kosower and S. W. Bauer. [1959] [4]p. incl. diagrs. tables, refs. (AFOSR-3174) (Sponsored jointly by [Air Force Office of Scientific Research under AF 49(638)282] and National Institutes of Health under E-1608) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 2191-2194, May 5, 1960.

The yellow intermediate formed in the dithionite reduction of DPN to DPNH is postulated to be a charge-transfer complex $DPN^+ - SO_2^=$, on the basis of comparison of the spectra of intermediates derived from both 3- and 4-carbamidopyridinium ions and sodium dithionite. (Contractor's abstract)

2989

Wisconsin U. Dept. of Chemistry, Madison.

HYDROGEN BONDING STUDIES. V. THE RELATIVE BASICITIES OF ETHERS, ALKOXYSILANES AND SILOXANES AND THE NATURE OF THE SILICON-OXYGEN BOND, by R. West, L. S. Whatley and K. J. Lake. [1960] [4]p. incl. diagrs. tables, refs. (AFOSR-TN-60-511) (AF 49(638)285) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 761-764, Feb. 20, 1961.

Ethers are slightly stronger bases than alkoxysilanes, and both of these classes of compounds are much stronger bases than siloxanes. The Si-O-Si π bonding in disiloxanes is best viewed as a three-center bond involving principally a single d-orbital on each Si atom and one of the 2p oxygen orbitals. The lowered basicity of the siloxanes is interpreted as resulting from the increased electron withdrawal from oxygen by π bonding to two Si atoms.

2990

Wisconsin U. Dept. of Chemistry, Madison.

SYMMETRICAL RESONANCE STABILIZED ANIONS, $C_nO_n^{-2}$, by R. West, H.-Y. Niu and others. [1960] [2]p. incl. diagr. (AFOSR-TN-60-1255) (AF 49(638)-285) AD 249890 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 6204-6205, Dec. 5, 1961.

The aim of this report is two-fold: (1) to indicate that the symmetrical resonance-stabilized anion $C_4O_4^{-2}$ mentioned by Cohen, Lacher, and Park, (Jour. Amer. Chem. Soc., v. 81: 3480, 1959) represents only one member of a general series of symmetrical electron-delocalized anions, $C_nO_n^{-2}$ and (2) to consider the next two higher members of the series, $C_5O_5^{-2}$ and $C_6O_6^{-2}$. As determined by Raman spectral measurements the croconate ion must have a five-fold symmetrical structure in aqueous solution. The symmetrical aromatic structure of $C_6O_6^{-2}$ is probable because of the similarity of the infrared spectrum to that of the croconate anion. Preliminary LCAO molecular orbital calculations of the delocalization energy in symmetrical anions $C_nO_n^{-2}$ indicate that the total delocalization energy increases as ring size increases from $C_3O_3^{-2}$ to $C_8O_8^{-2}$. Delocalization energy per atom decreases in the same sequence.

2991

Wisconsin U. [Dept. of Chemistry] Madison.

THE RELATIONSHIP BETWEEN O-H STRETCHING FREQUENCY AND ELECTRONEGATIVITY IN HYDROXIDES OF VARIOUS ELEMENTS, by R. West and R. H. Baney. [1959] [3]p. incl. table, refs. (AFOSR-2824) (AF 49(638)285) Unclassified

Also published in Jour. Phys. Chem., v. 64: 822-824, June 1960.

The O-H stretching band frequency was studied in Ph_3COH, Ph_3SiOH, Ph_3GeOH, Ph_3SnOH, and Ph_3PbOH, diphenylsilanediol, phenyldihydroxyborane, N-phenylhydroxylamine, and tert-butyl hydroperoxide. A least square treatment of the data for C, N, Sn, and Pb compounds yielded $\nu OH = 3750.6 - 54.1\chi$, where χ is the electronegativity of the element bonded to the OH group. The values of νOH were higher than would be expected from this equation in the case of triphenylsilanol, diphenylsilanediol, triphenylgermanol, and phenyldihydroxyborane. Dative σ bonding was assumed to take place in these compounds; this increases the s character of the O-H σ bond, and thereby increases the O-H force constant and frequency.

2992

Wisconsin U. Dept. of Chemistry, Madison.

HYDROGEN BONDING STUDIES. VI. THE HYDROGEN BONDING PROPERTIES OF ACETYLENES, by R. West and C. S. Kraihanzel. [1960] [4]p. incl. diagr. table, refs. [AF 49(638)285] Unclassified

Published in Jour. Amer. Chem. Soc., v. 83: 765-768, Feb. 20, 1961.

The relative acidity of terminal acetylenes as proton donors in hydrogen bond formation has been studied by

measuring the shifts of the acetylenic C-H infrared stretching bands upon hydrogen bonding to reference bases. The relative basicity of acetylene has been studied similarly by measuring the shifts of the O-H stretching band of phenol upon hydrogen bonding to the acetylenes. The results are explained in terms of inductive and resonance effects. Examination of the C-H stretching band of terminal acetylenes as a function of concentration indicates that these compounds are weakly associated by intermolecular hydrogen bonding. (Contractor's abstract)

2993

Wisconsin U. Dept. of Pharmacology, Madison.

EFFECTS OF ADRENALECTOMY AND DESOXYCORTICOSTERONE ON STOP-FLOW PATTERNS OF SODIUM AND POTASSIUM IN THE RAT, by H. E. Williamson, T. W. Skulan, and F. E. Shideman. [1960] [7]p. incl. diagrs. tables, refs. (AFOSR-TN-60-363) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)695 and National Institutes of Health under H-1634) AD 252725
Unclassified

Also published in Jour. Pharmacol. and Exper. Ther., v. 131: 49-55, Jan. 1961.

The technique of stop-flow for the localization of renal tubular function has been adapted for use in the rat. The patterns of concentration of Na, K, p-aminohippuric acid, and inulin in this species differ from those reported for the dog only in a quantitative fashion (Proc. Soc. Exper. Biol., N. Y., v. 99: 323, 1958). Whereas occlusive periods of longer duration (6 min) produce clear-cut patterns of concentration for p-aminohippuric acid and inulin and define the reabsorptive areas for Na and K, shorter periods of occlusion are essential for the visualization of distal tubular secretion of K. Maximal concentrations of the latter were observed following approx 1 min of occlusion. A diminished proximal tubular reabsorption of Na occurred within 4 days following adrenalectomy and persisted without significant alteration for 40 days post-operatively. A second change, a decrease in the capacity of the distal tubular mechanism to reabsorb Na, appeared later (21 days after adrenalectomy), and was maximal 28 days post-operatively. Shortly after adrenalectomy (4 days) data were obtained to suggest an increased reabsorptive capacity of the proximal tubules for K. No further alteration of K concentration in the stop-flow pattern occurred at a later time following operation. Administration of desoxycorticosterone restored the stop-flow concentrations of both Na and K to levels not significantly different from those of unoperated or sham-operated rats. (Contractor's abstract)

2994

Wisconsin U. Dept. of Zoology, Madison.

DAILY LIGHT SENSITIVITY RHYTHM IN A RODENT, by P. J. DeCoursey. [1960] [2]p. incl. diagrs. (AFOSR-TN-60-123) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)691, American Assoc. of University Women, and National Science Foundation) Unclassified

Also published in Science, v. 131: 33-35, Jan. 1, 1960.

An experiment is conducted to determine the effect of light on the endogenous rhythm in flying squirrels, Glaucomys volans. At intervals of 4 to 25 days the squirrels were exposed to 10 min of light/hr of an intensity of 0.5 ft-c; otherwise they remained in constant darkness at a uniform temperature. A phase shift was calculated as the difference between the expected and the actual time of activity onset for the activity period following the light shock. These phase shifts demonstrate a marked rhythm of light sensitivity. While sensitivity curves for different squirrels showed a similar form, they differed slightly from each other in details. Striking differences in the amount of phase shifting caused by equivalent light shocks were common for different individuals.

2995

Wisconsin U. [Dept. of Zoology] Madison.

PHASE CONTROL OF ACTIVITY IN A RODENT, by P. J. DeCoursey. [1960] [7]p. incl. diagrs. refs. (AFOSR-TN-60-1044) (AF 49(638)691) Unclassified

Also published in Cold Spring Harbor Symposia on Quantitative Biology, Cold Spring Harbor, N. Y. (June 5-14, 1960), New York, Long Island Biological Assoc., Inc., v. 25: 49-55, 1960.

In flying squirrels, the activity in natural conditions coincides with the period of darkness, and this relationship is maintained throughout the course of the year by the interaction of an endogenous activity rhythm and a related daily rhythm of responsiveness to light. Such a resetting rhythm could not be demonstrated to a variety of temperature or sound stimuli. (Contractor's abstract)

2996

Wisconsin U. Dept. of Zoology, Madison.

EFFECT OF LIGHT ON THE CIRCADIAN ACTIVITY RHYTHM OF THE FLYING SQUIRREL, GLAUCOMYS VOLANS, by P. J. DeCoursey. [1961] [24]p. incl. diagrs. tables, refs. (AFOSR-TN-60-1045) (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)691, American Assoc. for University Women, and National Science Foundation)
Unclassified

Also published in Zeitschr. vergleichende Physiol., v. 44: 331-354, 1961.

Research was conducted to elucidate the mechanism of synchronization by light in a nocturnal rodent, the flying squirrel (Glaucomys volans). The investigation was based on analysis of the activity patterns of 68 squirrels in recording cages for periods from several days to 3 yr. The squirrels were tested by constant dark conditions, by constant light conditions, by artificial day

schedules out of phase with the animal's internal rhythm, and by resetting the internal clock by light. From the results it is concluded that light is the primary environmental synchronizer of endogenous rhythms. While there is no evidence that other rhythmic factors of the environment can act as time-givers for Glaucomys volans, there are suggestions that sound, temperature, and feeding cycles may be secondary in other species.

2997

Wisconsin U. Dept. of Zoology, Madison.

STUDIES ON THE INTERNAL CLOCK REGULATING DAILY ACTIVITY RHYTHMS IN RODENTS, by P. J. DeCoursey. Final rept. Aug. 24, 1960, 6p. (AFOSR-TR-60-119) (AF 49(638)691) AD 244958; PB 152631
Unclassified

Research was conducted on the characteristics of endogenous rhythms and the nature and mode of action of environmental synchronizers. The research was divided into 3 parts: (1) The detailed analysis of the specificity of environmental synchronizers in 1 species (Glaucomys volans). An animal was changed from a constant environment to one with a single fluctuating factor, and an animal in a constant environment was changed to one with a single, isolated, short stimulus at various points in its activity cycle. Neither sound, temperature, nor feeding clues evoked response. Light appears to be the primary if not the exclusive synchronizer. (2) Comparative aspects in nocturnal rodents. Tests were made to compare the rhythms of the European doormouse, the white-footed door mouse, the hazel mouse, the jumping mouse, the northern flying squirrel, the golden hamster, the pocket gopher, and several varieties of the laboratory rat. From this work it appears that a basic pattern of activity regulation may occur in nocturnal, non-fossorial rodents based on the interaction of an endogenous timer and a related daily rhythm of light resetting. (3) Activity rhythms in day-active species of animals. The chipmunk, the red squirrel, the white-tailed antelope squirrel, Harris' antelope squirrel, and several species of birds were tested. The general procedure was to record activity rhythms under natural or artificial day conditions, constant light or dark conditions, and under shifts of the light-dark cycle out of phase with an individual's locomotor rhythm. These results suggest that possibly periods of darkness at certain times in the daily rhythm of an individual could reset the endogenous timer and cause synchronization. A few species of the antelope squirrel seem to be in accordance with this hypothesis.

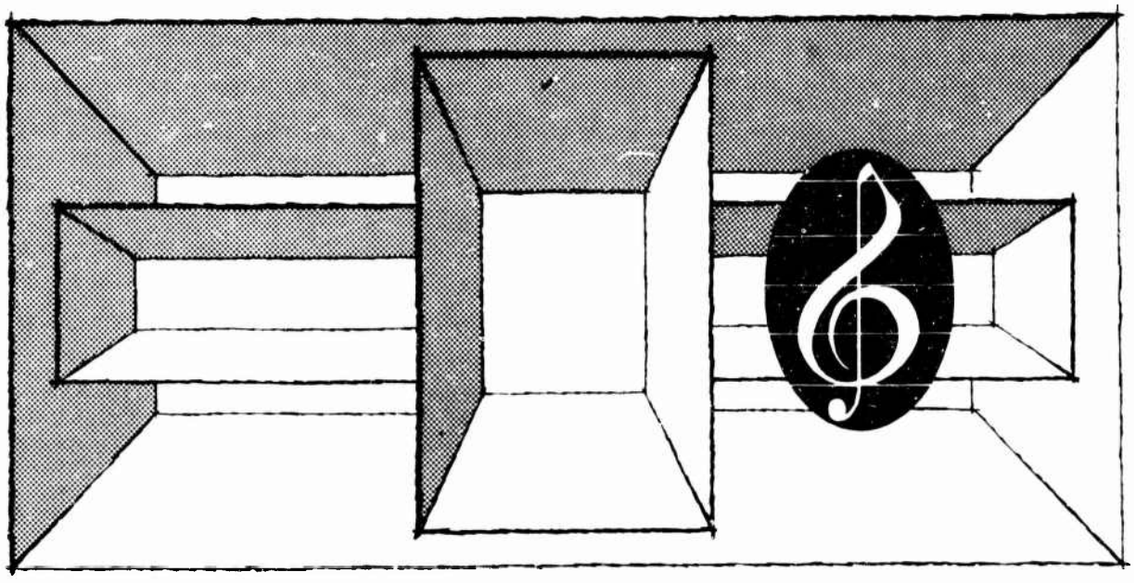
2998

Wright Air Development Directorate. Aeronautical Research Lab., Ohio.

LORENTZ-INVARIANT GRAVITATIONAL THEORY, by W. E. Thirring, tr. by J. Goldberg. [1959] 28p. incl. refs. (AFOSR-TN-60-1238) AD 245195
Unclassified

Also published in Forschritte Phys., v. 7: 79-101, 1959.

The use of the Lorentz-invariant as a modern tool of scientific logic is reaffirmed. The Mach principle is used as the line of reasoning to introduce the presentation. This investigation was motivated by the desire to enlarge or even replace by arguments used in the formation of other empirically verified field theories the line of reasoning used by Einstein in the construction of general relativity. It is concluded that construction of a Lorentz-invariant gravitational theory, according to the usual recipes today, leads fairly directly to the Einstein theory with all its noteworthy assertions and concepts.



2999

[Yale U. Dept. of Mathematics, New Haven, Conn.]

BROWNIAN MOTION OF ROTATION, by C. D. Gorman. [1958] [15]p. (AF 18(600)1127) Unclassified

Published in Trans. Amer. Math. Soc., v. 94: 103-117, Jan. 1960.

Brownian motion on the surface of a 3-sphere is constructed, by a direct application of the formula for the composition of probabilities, from the plane Brownian motion. The construction is described as follows: Let $(x(t), y(t))$, $0 \leq t < \infty$, be the plane Brownian motion. For each nonnegative integer n, let the interval [0,1] be subdivided by the points $k/2^n$ ($k = 0, 1, \cdots, 2^n$). Put

$$x^{(n)}(t) = x\left(\frac{k-1}{2^n}\right) + 2^n\left(t - \frac{k-1}{2^n}\right)\left[x\left(\frac{k}{2^n}\right) - x\left(\frac{k-1}{2^n}\right)\right],$$

$$y^{(n)}(t) = y\left(\frac{k-1}{2^n}\right) + 2^n\left(t - \frac{k-1}{2^n}\right)\left[y\left(\frac{k}{2^n}\right) - y\left(\frac{k-1}{2^n}\right)\right] \text{ for}$$

$(k-1)/2^n \leq t < k/2^n$ ($k = 1, \cdots, 2^n$; $n = 0, 1, \cdots$). Let S be a sphere of radus 1 placed on the x-y plane touching at the origin. Assume that S rolls without slipping along the polygonal path $\{(x, y) \mid x = x^{(n)}(t), y = y^{(n)}(t), 0 \leq t \leq 1\}$ in such a way that it has constant angular velocity along each linear portion of the path corresponding to the intervals of time $(k-1)/2^n \leq t < k/2^n$ ($k = 1, \cdots, 2^n$). Let, for each $t \in [0, 1]$, $R^{(n)}(t)$ be the rotation of S around its center as it rolls in the above manner from the origin to the point $(x^{(n)}(t), y^{(n)}(t))$. Thus, for each sample path of plane Brownian motion process, we obtain a sequence $R^{(n)}(t)$ ($0 \leq t \leq 1$; $n = 0, 1, \cdots$) of sample paths in the space of the group of rotations of the 3-sphere. The main theorem states that $\lim_{n \to \infty} R^{(n)}(t)$ exists uniformly in t ($0 \leq t \leq 1$), for all sample paths of the plane Brownian motion process. (Math. Rev. abstract)

3000

Yale U. [Dept. of Mathematics] New Haven, Conn.

ON A HOMOMORPHISM PROPERTY OF CERTAIN JORDAN ALGEBRAS, by A. A. Albert and L. J. Paige. [1958] [10]p. (Sponsored jointly by Air Force Office of Scientific Research under AF 18(603)58, Army Research Office (Durham) under DA 19-059-ORD-2329, and National Science Foundation under G-5255 and G-4792) Unclassified

Presented at Internat'l. Cong. of Mathematicians, Edinburgh (Scotland), Aug. 19, 1958. (Title varies)

Published in Trans. Amer. Math. Soc., v. 93: 20-29, Oct. 1959.

The purpose of this paper is to provide a proof of the following basic result. Let $\mathfrak{D}$ be any (nonassociative) algebra with a unity element e over a field $\mathfrak{F}$ of characteristic not 2 and possessing an involution T over $\mathfrak{F}$. Let $\mathfrak{H}_0$ be the algebra of all 3 rowed T-hermitian matrices over $\mathfrak{D}$ relative to Jordan multiplication. Then, if $\mathfrak{H}_0$ is a homomorphic image of the special Jordan algebra $\mathfrak{H}$, the algebra $\mathfrak{D}$ is associative.

3001

[Yale U. Dept. of Mathematics, New Haven, Conn.]

HOMOMORPHISMS OF COMMUTATIVE BANACH ALGEBRAS, by W. G. Bade and P. C. Curtis, Jr. [1959] [20]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)153, National Science Foundation, and Office of Naval Research under Nonr-23359) Unclassified

Published in Amer. Jour. Math., v. 82: 589-608, July 1960.

Let $\mathfrak{A}$ and $\mathfrak{B}$ be commutative Banach algebras, and ν be an arbitrary (not necessarily continuous) homomorphism of $\mathfrak{A}$ into $\mathfrak{B}$. The continuity properties of ν which arise from the algebraic structure of $\mathfrak{A}$ are studied. The main results are grouped around the following topics: (1) The degree of discontinuity which ν may have on the set of idempotents of $\mathfrak{A}$. (2) The localization of the discontinuity of ν to a finite set of points of the structure-space $\Phi_{\mathfrak{A}}$ of $\mathfrak{A}$ when $\mathfrak{A}$ is a regular algebra in the sense of Silov. (3) The question of the existence of discontinuous homomorphisms on the algebra $C(\Omega)$ of all continuous functions on a compact Hausdorff space. (4) The construction of algebras which are not normed algebras under any norm. If ν is a homomorphism of $\mathfrak{A}$ into a Banach algebra $\mathfrak{B}$, then the function $x \to "\nu(x)"$ (where $x \in \mathfrak{A}$), is a multiplicative semi-norm on $\mathfrak{A}$. Conversely, every multiplicative semi-norm is the norm of a homomorphism; consequently, the results in this paper could be stated equivalently in terms of continuity properties of multiplicative semi-norms on $\mathfrak{A}$. Section 1 contains preliminary material concerning adjunction of units and the relation of multiplicative semi-norms to homomorphisms. Section 2 states the key result: If a bounded sequence $\{g_n\}$ of elements of $\mathfrak{A}$ is separated by orthogonal relative units (elements h_n of $\mathfrak{A}$ satisfying $g_n h_n = g_n$, $h_n h_m = 0$, $m \neq n$), then under any homomorphism ν: $\mathfrak{A} \to \mathfrak{B}$, the norms of the elements $\nu(g_n)$ in $\mathfrak{B}$ cannot grow faster than the norms of the relative units h_n in $\mathfrak{A}$. In section 3 the algebra $\mathfrak{A}$ is supposed to be semi-simple, with unit, and to be regular in the sense of Silov. Section 4 strengthens the results of section 3 for the case of the special Banach algebra $C(\Omega)$. Section 5 deals with the non-normability of certain quotient algebras.

3002

Yale U [Dept. of Mathematics] New Haven, Conn.

TRIGONOMETRIC SERIES WITH GAPS, by W. Rudin. [1960] [25]p. incl. refs. (AF 49(638)153)
Unclassified

Published in Jour. Math. and Mech., v. 9: 203-227, Mar. 1960.

Trigonometric series with gaps are analyzed. Topics considered are; (1) Sidon sets, (2) structural properties of sets of type $\Lambda(q)$, and (3) analytic properties of sets of type $\Lambda(p)$. The various problems are suggested by the following well-known theorems (Trigonometrical Series, Warsaw, 1935, p. 122, 139, 216). (A) If f is a Lebesgue-integrable function on the unit circle whose Fourier series has the form of

$f(e^{i\theta}) \sim \sum_{k=1}^{\infty} a_k e^{in_k\theta}$, where $\{n_k\}$ is a Hadamard set,

then $f \in L^p$ for every $p < \infty$. (B) If, in addition, f is bounded, then $\Sigma |a_k|^2 < \infty$.

3003

[Yale U. Dept. of Mathematics, New Haven, Conn.]

THE WEDDERBURN DECOMPOSITION OF COMMUTATIVE BANACH ALGEBRAS, by W. G. Bade and P. C. Curtis, Jr. [1960] [16]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under AF 49(638)153, National Science Foundation, and Office of Naval Research under Nonr-23359) Unclassified

Published in Amer. Jour. Math., v. 82: 851-866, Oct. 1960.

A complex Banach algebra $\mathfrak{A}$ with radical $\mathfrak{R}$ is called 'decomposable' if there is a (possibly non-closed) subalgebra $\mathfrak{B}$ of $\mathfrak{A}$ with $\mathfrak{A} = \mathfrak{B} + \mathfrak{R}$, $\mathfrak{B} \cap \mathfrak{R} = \{0\}$, and 'strongly decomposable' if a closed such subalgebra $\mathfrak{B}$ exists. Following Feldman (Proc. Amer. Math. Soc., v. 2: 771-777, 1951), the decomposability of $\mathfrak{A}$ to properties of $\mathfrak{R}$ and $\mathfrak{A}/\mathfrak{R}$ is related. For an $\mathfrak{A}$ with identity in which the set P of all idempotents is commutative and for which $\mathfrak{A}/\mathfrak{R}$ is commutative with totally disconnected maximal ideal space, the following criterion is proved: $\mathfrak{A}$ is decomposable, and $\mathfrak{A}/\mathfrak{R} \cong C(\Phi)$ (algebraic isomorphism) if and only if P is bounded; in this case $\mathfrak{A}$ is strongly decomposable, and uniquely so. If moreover $\mathfrak{R}$ is nilpotent, then the decomposition is necessarily strong. For a Banach algebra $\mathfrak{A}$ with the set P commutative, it is proved that a sufficient condition for boundedness of P is the satisfaction by P of a weak interpolation axiom, shown to be equivalent, when $\mathfrak{A}$ is commutative with totally disconnected maximal ideal space Ω, to the statement that Ω is an F-space in the sense of Gillman and Henriksen (Trans. Amer. Math. Soc., v. 82: 366-391, 1955). This extends a result of Bade (Trans. Amer. Math. Soc., v. 80: 345-360, 1955). One consequence is that for a totally disconnected compact F-space Ω the algebra $C(\Omega)$ is the only semi-simple commutative Banach algebra with Ω as maximal ideal space. For a commutative $\mathfrak{A}$, conditions on the radical sufficient for decomposability under the assumption that $\mathfrak{A}/\mathfrak{R} = C(\Omega)$ for a compact Ω are found: the algebra $\mathfrak{A}$ is strongly decomposable if $\mathfrak{R}$ has finite dimension, which in turn is true if Ω is totally disconnected and $\mathfrak{R}$ nilpotent. Examples are supplied to show that neither of the conditions (a) $\mathfrak{A}/\mathfrak{R} \cong C(\Omega)$ with Ω totally disconnected and (b) $\mathfrak{R}$ is nilpotent, is sufficient for strong decomposability.

3004

Yale U. [Dept. of Mathematics] New Haven, Conn.

FAITHFUL-REPRESENTATIONS OF NORMED ALGEBRAS, by B. Yood. [1960] [19]p. incl. refs. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)153] and National Science Foundation)
Unclassified

Published in Pacific Jour. Math., v. 10: 345-363, 1960.

The problem is discussed of deciding whether an Arens *-algebra is a B *-algebra for an equivalent norm. The problem of the existence of faithful *-representations of Banach algebras with involution is also discussed. Also included is an analysis preliminary ring theory and normed algebras with minimal ideals. Results are given along with several conclusions.

3005

[Yale U. Dept. of Mathematics, New Haven, Conn.]

A NOTE CONCERNING CERTAIN PRODUCT SPACES, by P. C. Curtis, Jr. [1960] [3]p. (AF 49(638)153)
Unclassified

Published in Arch. der Math., v. 11: 50-52, 1960.

If X and Y are infinite compact Hausdorff spaces, then X x Y contains two disjoint open sets of type F_σ whose closures intersect. The proof of the above given by Walter Rudin is described. A generalization of this result to spaces considered by Gillman and Henriksen defines a completely regular space X to be an F' space if for each $f \in C(X)$, the ring of real valued continuous functions on the space X, $P(f) \cap N(F) = \varphi$, where $P(f) = \{x \in X : f(x) > 0\}$ and $N(f) = \{x \in X : f(x) < 0\}$. If X is a normal space, this condition is equivalent to the condition that each pair of disjoint open F_σ sets of X have disjoint closures. Thus Rudin's result may be restated as follows: An F' space is never the product of 2 infinite compact spaces. This question is considered here with the assumption of compactness removed. The author gives a complete proof of his theorem. Let X and Y be 2 completely regular Hausdorff spaces. If X x Y is an F' space, then 1 component is a P space and the other is an F' space. Conversely suppose X is a P space and Y

is an F' space. If X is discrete or Y is locally separable, then X x Y is an F' space. The following corollary is also given: The product of 2 locally compact spaces is an F' space if and only if 1 space is discrete and the other is an F' space.

3006

Yale U. [Dept. of Mathematics] New Haven, Conn.

GROUPS WITH REPRESENTATIONS OF BOUNDED DEGREE II, by S. A. Amitsur. [1960] [8]p. [AF 49-(638)153] Unclassified

Published in Illinois Jour. Math., v. 5: 198-205, June 1961.

Kaplansky has shown (Canadian Jour. Math., v. 1: 105-112, 1949) that if G (infinite groups) contains a normal abelian subgroup of finite index, then all the irreducible representations of G are of bounded degree, and has obtained a bound utilizing identities of finite matrix rings and the theory of Banach algebras. Employing additional information concerning identities of matrix rings and of discrete algebra groups, more concrete results are obtained in this direction. The result that if G contains any abelian (not necessarily normal) subgroup of index n in G, then all representations of G are of degree $\leq n$, is obtained. The converse is not true even for n = 2. In this case, all groups whose irreducible representation are finite-dimensional of degree ≤ 2 are determined and shown to belong to 2 types: (1) groups G having a normal abelian subgroup of index 2, and (2) groups G having a center N such that G/N is an abelian 2-group of order 8.

3007

Yale U. [Dept. of Mathematics] New Haven, Conn.

ERGODIC AND MIXING PROPERTIES OF INFINITE MEMORY CHANNELS, by R. L. Adler. [1960] [7]p. (AF 49(638)224) Unclassified

Published in Proc. Amer. Math. Soc., v. 12: 924-930, Dec. 1961.

The source-channel condition expresses that the output of a channel be asymptotically independent from the remote past of the input. The method of proof is an application of a functional form of the notion of ergodicity involving Cesàro convergence of a certain sequence of integrals. In addition this technique can be used to discuss some of the mixing and ergodic properties of the output with respect to the input and the channel. (Contractor's abstract, modified)

3008

[Yale U. Dept. of Mathematics] New Haven, Conn.

SOME GROUPS OF TRANSFORMATIONS BY JORDAN ALGEBRAS. II. GROUPS OF TYPE F_4, by N. Jacobson. [1960] [25]p. incl. refs. (AFOSR-39) (AF 49(638)515) AD 263971 Unclassified

Also published in Jour. Reine und Angew. Math., v. 204: 74-98, 1960.

One of the types of linear groups defined as the groups of automorphisms of central simple exceptional Jordan algebras is studied. This can be considered as the second step in a program of studying exceptional groups analogous to the exceptional simple Lie groups via non-associative algebras. The counterparts of the Lie group F_4 as groups of automorphisms of exceptional Jordan algebras are considered.

3009

[Yale U. Dept. of Mathematics] New Haven, Conn.

SOME GROUPS OF TRANSFORMATIONS DEFINED BY JORDAN ALGEBRAS. III. GROUPS OF TYPE E_{61}, by N. Jacobson. [1960] [25]p. incl. refs. (AFOSR-1018) (AF 49(638)515) AD 263970 Unclassified

Also published in Jour. Reine und Angew. Math., v. 207: 61-85, 1961.

A study is made of certain mathematical groups of transformations as defined by Jordan algebras. A number of theorems and propositions on matrix algebras, projective geometry, and simple groups, i.e., Lie groups, are given.

3010

Yale U. [Dept. of Physics] New Haven, Conn.

STATISTICAL LINE BROADENING IN PLASMAS, by H. K. Wimmel. [1960] [29]p. incl. diagrs. tables, refs. (AFOSR-TN-60-776) (Sponsored jointly by Air Force Office of Scientific Research under [AF 18(603)15] and Office of Naval Research) Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 1: 1-29, Sept. 1961.

The conditions under which ion broadening of spectral lines emitted from neutral atoms in plasmas can be described by the statistical theory are investigated by studying the fluctuations of the electric microfield acting on a radiating atom. The Fourier-integral formula for the line shape reveals three effects that cause deviations from the statistical line shape. On representing the correlation function by a Taylor expansion in time,

an expansion for the line shape is obtained that satisfies the wing theorem and likewise reduces to Holtsmark's line shape for high densities and low temperatures. The first-order correction to the statistical line shape is evaluated numerically; it vanishes near the maximum of the Holtsmark line shape (reduced fieldstrength β = 1.6), while the maximal deviations occur in the ranges $\beta \approx 1$ and $\beta \approx 3$, the overall effect being an intensity shift towards larger values of β. The average absolute magnitude of the correction reaches 38% and 16% for H_β and H_γ at $T = 10^{4.0}$ K and $n_{ion} = 10^{17}$ cm^{-3} in the range $0.6 \leq \beta < 10$. (Contractor's abstract, modified)

3011

Yale U. [Dept. of Physics] New Haven, Conn.

CLUSTER APPROACH TO THE THEORY OF LINE BROADENING BY IONS, by H. K. Wimmel and M. B. Lewis. Apr. 1, 1959 [23]p. incl. table. (AFOSR-TN-60-778) (Also bound with its Status rept. AD 289412) (AF 18(603)15) Unclassified

Presented at meeting of the Amer. Phys. Soc., Milwaukee, Wis., June 18-20, 1959.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 4: 318, June 18, 1959. (Title varies)

For abstract see item no. 2250, Vol. III.

3012

Yale U. [Dept. of Physics] New Haven, Conn.

FORMULAS FOR ESTIMATING WIDTHS OF SPECTRAL LINES EMITTED FROM PLASMAS AND THEIR LIMITS OF VALIDITY, by H. Margenau. [1960] [9]p. incl. diagrs. (AFOSR-TN-60-779) (AF 18(603)15) AD 282887 Unclassified

Also published in Proc. Fourth Internat'l. Conf. on Ionization Phenomena in Gases, Uppsala (Sweden) (Aug. 17-21, 1959), Amsterdam, North-Holland Publishing Co., v. 2: IIID 799-IIID 807, 1960.

General directives are given for estimating the width of spectral lines broadened by Stark effects. Since the behavior of lines showing a first-order Stark effect is wholly different from the broadening of second-order Stark lines, a separate study of these 2 categories must be made. The first includes only the lines of atomic hydrogen and hydrogen-like ions; the second concerns a more embracive class. Helium lines, for which the Stark effect is quadratic in weak fields but linear in strong fields, are not included. The approach involves defining physical conditions under which impact and statistical regions are valid, and in each case the regime of the Doppler effect is held in view. Three different regions in the n-T plane are distinguished and plotted, n being the number density of ions (electrons) and T the absolute temperature. In region I both electrons and ions can be treated by impact theory. In II, ions are subject to statistical and electrons to impact description, whereas in III both behave statistically. (Contractor's abstract, modified)

3013

Yale U. [Dept. of Physics] New Haven, Conn.

THEORY OF PRESSURE EFFECTS ON ALKALI DOUBLET LINES, by L. Klein and H. Margenau. [1958] [10]p. incl. diagrs. tables, refs. (AFOSR-TN-60-782) [AF 18(603)15] Unclassified

Also published in Jour. Chem. Phys., v. 30: 1556-1565, June 1959.

The bands, caused by the pressures of noble gases, which appear in both the red and violet wings of the alkali doublet lines and the shift and shape of those lines are explained. Shift and broadening of the two components of the alkali doublet lines are calculated as functions of noble gas density by considering the van der Waals energy perturbation due to n simultaneously acting perturbers. The conclusion, which is in agreement with experiments, is that the $^2P_{3/2}$ resonance line is shifted and broadened more than the $^2P_{1/2}$ resonance line at moderate pressures. A phenomenological approach is used to construct a more reasonable theory of the "satellite" bands. In the absence of reliable knowledge concerning the repulsive portions of the interaction curves, only a semiquantitative understanding of the data is achieved. (Contractor's abstract, modified)

3014

Yale U. [Dept. of Physics] New Haven, Conn.

FREQUENCY SHIFTS IN HYPERFINE SPLITTING OF ALKALIS CAUSED BY FOREIGN GASES, by H. Margenau, P. Fontana, and L. Klein. [1959] [6]p. incl. diagrs. tables, refs. (AFOSR-TN-60-783) (Also bound with its Status rept. AD 289412) [AF 18(603)15] Unclassified

Also published in Phys. Rev., v. 115: 87-92, July 1, 1959.

The difference in the dispersion force between an alkali atom in a particular hyperfine level belonging to the ground state and a perturbing molecule is computed. These asymptotic forces, if active alone, generally produce red shifts and suffice to account for the results obtained for the heavier buffer gases. Experimental data exhibit blue shifts for the lighter gases and therefore indicate that the net frequency shifts are the result of exchange as well as dispersion forces. The former cannot be determined theoretically. Therefore, a simple model is devised in which the difference in the forces is given a positive trend at distances of separation smaller

than d, while beyond d it is given the calculated form. The experimental data for all alkali-rare gas interactions can then be fitted by values of d which, for the different foreign gases, are of the order of their gas-kinetic diameters. (Contractor's abstract)

3015

Yale U. [Dept. of Physics] New Haven, Conn.

ENERGY OF INTERACTION OF TWO HELIUM ATOMS, by N. Moore. [1960] [10]p. incl. diagrs. tables, refs. (AFOSR-TN-60-786) [AF 18(603)15] Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 231, Apr. 25, 1960.

Published in Jour. Chem. Phys., v. 33: 471-480, Aug. 1960.

The interaction energy of 2 helium atoms in the ground state is calculated as a function of internuclear separation. Use is made of a variational trial state function developed in analogy with Hirschfelder and Linnett's treatment of the hydrogen-hydrogen interaction. The results are in good agreement with the best previous treatments in the repulsive region as well as with the results of Rosen, Margenau, and Page in the neighborhood of the van der Waals minimum; in addition, information is obtained concerning the instantaneous mutual polarization of the 2 atoms. (Contractor's abstract)

3016

Yale U. [Dept. of Physics] New Haven, Conn.

STARK BROADENING OF SPECTRAL LINES BY HIGH-VELOCITY CHARGED PARTICLES, by M. Lewis. [1960] [5]p. (AFOSR-TN-60-788) [AF 18(603)15] Unclassified

Published in Phys. Rev., v. 121: 501-505, Jan. 15, 1961.

The broadening of the Lyman α line by high-v city charged particles is calculated in the classic th approximation without the completed-collisio mption. For noninteracting perturbers, the divergence at large impact parameters associated with usual impact theories does not arise. Interactions between the perturbers are introduced by the pair correlation function. The resulting line shape is valid for frequencies larger than those permitted by impact theory. (Contractor's abstract)

3017

Yale U. [Dept. of Physics] New Haven, Conn.

FORBIDDEN HELIUM LINE IN A PLASMA SPECTRUM, by H. Sadjian, H. K. Wimmel, and H. Margenau. [1960] [7]p. incl. diagrs. (AFOSR-J70) (In cooperation with General Electric Co., Philadelphia, Pa.) (AF 18(603)15) AD 400452 Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 1: 46-52, Sept. 1961.

The appearance of forbidden spectral lines in a plasma yields a means of determining the plasma ion density by measuring relative intensities or frequency shifts. A simple static analysis is applied to the He I lines $4^1D - 2^1P$ and yields an ion density of 5×10^{16} cm^{-3}. (Contractor's abstract)

3018

Yale U. Dept. of Physics, New Haven, Conn.

SIMULTANEOUS EFFECT OF DOPPLER AND FOREIGN GAS BROADENING ON SPECTRAL LINES, by L. Galatry. [Dec. 1960] [6]p. incl. diagrs. refs. (AFOSR-J71) (AF 18(603)15) AD 400453 Unclassified

Also published in Phys. Rev., v. 122: 1218-1223, May 15, 1961.

By using the classical Fourier integral theory, an expression is given for the shape of a spectral line, broadened by phase changes due to collisions and by actual changes in velocity of the emitting particles resulting from collisions. The result is not simple Volgt-type folding of an exponential into a dispersion distribution; it exhibits the contraction noted by Dicke and leads to the usual formulas when the time interval between path-deflecting or phase-disturbing collisions becomes very great. (Contractor's abstract)

3019

Yale U. [Dept. of Physics] New Haven, Conn.

FREQUENCY SHIFTS IN HYPERFINE SPLITTING OF ALKALIS: A CORRECTION, by R. Herman and H. Margenau. [1960] [3]p. incl. tables. (AFOSR-64-1047) (Sponsored jointly by [Air Force Office of Scientific Research under AF 18(603)15] and Office of Naval Research) AD 441500 Unclassified

Also published in Phys. Rev., v. 122: 1205-1206, May 15, 1961.

The effect of the deformation of the wave functions by Van der Waals interactions, previously ignored, upon the hyperfine shifts of alkali caused by rare gas atoms is computed. It is found to be large and clearly in need

of consideration. When applied to the experimentally observed shifts, the model proposed earlier, with the new values of the interaction constants, leads to interaction radii somewhat greater than before and more nearly equal to gas kinetic radii. (See also item no. 3014, Vol. IV)

3020

Yale U. [Dept. of Physics] New Haven, Conn.

THE STRUCTURE OF SPECTRAL LINES FROM PLASMAS, by H. Margenau. [1959] [8]p. incl. diagrs. table. (AFOSR-64-2403) (AF 18(603)15) Unclassified

Also published in Proc. Fourth Internat'l. Conf. on Ionization Phenomena in Gases, Uppsala (Sweden) (Aug. 17-21, 1959), Amsterdam, North-Holland Publishing Co. v. 2: IIID 791-IIID 798, 1960.

A brief summary of the main ideas involved in line width problems are considered. Natural line width and Doppler Effect are compared in the optical and the microwave regions. Lorentz's theory of line broadening by perturbing atoms is discussed in addition to 2 types of theory (statistical and modified impact) which have been developed to improve Lorentz's analysis. The most simple of the modified impact theories, that of Weisskopf, is discussed. The statistical theory of Holtsmark which has been widely used in plasma investigations is reviewed.

3021

[Yale U. Dept. of Physics, New Haven, Conn.]

ISOTHERMAL FLOW OF SUPERFLUID HELIUM IN A 1.1 MM CAPILLARY, by J. N. Kidder and W. M. Fairbank. [1960] [3]p. incl. diagrs. table. (AFOSR-2863) [AF 49(638)690] AD 281358 Unclassified

Also published in Proc. Seventh Internat'l. Conf. on Low Temperature Phys., Toronto U. (Canada) (Aug. 29-Sept. 3, 1960), Toronto U. Press, 1961, p. 560-562.

A very sensitive technique was used to measure the pressure gradient along a 1.1 mm capillary in which the superfluid component of liquid He II was flowing isothermally. A critical flow velocity (v_c), below which no pressure gradient could be detected, was observed directly. It is believed that the resistance to superfluid flow, observed at velocities up to three times the v_c, is due to an interaction between the vortex lines in the superfluid and the walls of the capillary. The experimental procedure, designed primarily to investigate the zero region pressure gradient superfluid flow, is described. The apparatus was able to detect pressure gradients of 3×10^{-4} dynes/cm^3. The obtained results are discussed.

3022

Yale U. [Dept. of Physics] New Haven, Conn.

CROSS SECTION AND POLARIZATION IN THE PHOTODISINTEGRATION OF THE DEUTERON, by M. L. Rustgi, W. Zernik and others. [1960] [17]p. incl. diagrs. tables, refs. (AFOSR-TN-60-828) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49-(638)752] Atomic Energy Commission, and Office of Ordnance Research) AD 254218 Unclassified

Published in Phys. Rev., v. 120: 1881-1897, Dec. 1, 1960.

The differential cross section and polarization of nucleons from the $H^2(\gamma,n)H^1$ reaction is investigated arranging calculations by means of the amplitude method. Electric dipole, electric quadrupole, and magnetic dipole transitions are considered taking into account coupling between states with the same J but different L such as produced by the tensor potential. The calculations include the general case of elliptically polarized gamma rays. Numerical results are obtained for two modified versions of the Signell-Marshak two-nucleon potential. Five approximations have been used to exhibit the effects of the various multipole transitions. The calculations agree with experiment rather well even at energies for which the potential used does not represent scattering data at all perfectly. The significance of polarization measurements is discussed. (Contractor's abstract)

3023

Yale U. [Dept. of Physics] New Haven, Conn.

MOTT-SCATTERING ANALYSIS OF LONGITUDINAL POLARIZATION OF ELECTRONS FROM Co^{60}, by J. S. Greenberg, D. P. Malone and others. [1960] [13]p. incl. diagrs. refs. (AFOSR-TN-60-1202) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(633)752] Atomic Energy Commission, and Office of Naval Research) AD 249044 Unclassified

Also published in Phys. Rev., v. 120: 1393-1405, Nov. 15, 1960.

Mott scattering was used to analyze the degree of longitudinal polarization of beta particles emitted from radioactive nuclei. The reliability of this method and the influences of the various systematic errors associated with this method on the accuracy of the measurement were investigated in detail and are discussed. On the basis of a linear extrapolation of the inverse of the Mott asymmetry to zero scattering thickness, the polarization of 194-kev electrons from Co^{60} was found to be $-(0.994 \pm 0.057)v/c$ with all known corrections applied. The effects of atomic screening and finite nuclear

size were not included. Using the quoted value for the polarization measured in the pure Gamow-Teller transition in Co^{60} yields $C_{A'} = (0.7 \text{ to } 1.45)C_A$.

3024

Yale U. [Dept. of Physics] New Haven, Conn.

COULOMB DISINTEGRATION OF Li^6 BY HEAVY NUCLEI, by R. L. Gluckstern and G. Breit. [1960] [9]p. incl. diagrs. (AFOSR-827) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)-752] and Atomic Energy Commission) AD 613194 Unclassified

Presented at meeting of the Amer. Phys. Soc., Chicago, Ill., Nov. 25-26, 1960.

Published in Proc. Second Conf. on Reactions Between Complex Nuclei, Gatlinburg, Tenn. (May 2-4, 1960), New York, Wiley and Sons, 1960, p. 77-85.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 474, Nov. 25, 1960.

In connection with observations on disintegration of Li^6 in collision with Au, calculations regarding the effect of the electric field of a heavy target causing $\alpha + d$ breakup have been made. Estimates of E2 transitions from the ground state (1+) of Li^6 to excited states 2.18 mev (3+), 4.52 mev (2+), and 5.5 mev (1+) have been carried out and angular distributions of alpha particles resulting from the disintegration of these states approximately calculated. For bombarding energies between 30 and 60 mev the 3+ level appears to be the more important. Quantitative comparison proved difficult on account of (a) uncertainties regarding wave functions and transition moments, (b) apparent largeness of excitation probabilities suggesting possible importance of cascade excitations and reorientation effects, (c) probable participation of stripping especially at higher bombarding energies. Although it has not proved possible to derive from measurements values of transition moments B(E2), the variation of $\sigma(\alpha)$ with energy and angle suggests that Coulomb disintegration is a major contributor.

3025

Yale U. [Sloane Physics Lab.] New Haven, Conn.

EFFECT OF FINITE LIFE OF UPPER LEVEL ON PROBABILITY OF COULOMB EXCITATION, by G. Breit and R. L. Gluckstern. [1960] [14]p. incl. table, refs. (AFOSR-TN-60-615) (Sponsored jointly by Air Force Office of Scientific Research under AF 18(600)-771 and Atomic Energy Commission under AT(30-1) 1807) Unclassified

Also published in Nuclear Phys., v. 20: 188-201, Oct. 1960.

The effect of the finite life of the upper level on the probability of Coulomb excitation is calculated in the semiclassical approximation. The problem is first treated by considering the upper level to be coupled to the continuum by means of a matrix element as in the Weisskopf-Wigner treatment of emission and absorption in radiation theory. Equations for the excitation probability at intermediate times are worked out. The overall transition probability from the ground state to the continuum is transformed in terms of an integral over energies for a transition to a level with infinite life time. The result is then interpreted and generalized in terms of direct transitions to the continuum of stationary states without making use of the division of the nuclear Hamiltonian into parts which provided the matrix element of the first treatment. The second approximation provides a more accurate formula for the overall transition probability and relates the Coulomb excitation probability directly to the Einstein absorption probabilities per unit frequency range. A schematic illustration is given for the increase in the number of transitions from the ground state. (Contractor's abstract)

3026

Yale U. [Sloane Physics Lab.] New Haven, Conn.

PART I. ATOMIC BEAM MAGNETIC RESONANCE EXPERIMENTS. PART II. MUONIUM; POSITRONS, by V. W. Hughes. Final interim rept. Oct. 1, 1955-Sept. 30, 1959. Dec. 15, 1959, 4p. incl. refs. (AFOSR-TR-60-1) (AF 18(600)1565) Unclassified

This work has included two related fields of research: (1) atomic beam magnetic resonance studies and (2) muonium, muon depolarization, and positron annihilation. In the first category, high precision measurements have been made of atomic electronic magnetic moments in helium in its $^3S_1$ metastable state and in neon and argon in their $^3P_2$ metastable states. Also, the hyperfine structure of He^3 has been remeasured with greatly increased precision. Finally, an experimental confirmation of the theory of resonance line shapes in atomic beam experiments has been made. Under part (2), extensive search has been made for the atom consisting of a μ^+ meson and an electron, which is called muonium. As yet, this atom has not been found, but interesting experimental results have been obtained on questions of the depolarization of muons in gases and in liquid helium. (Contractor's abstract)

3027

Yale U. [Sloane Physics Lab.] New Haven, Conn.

EXPERIMENTAL CONFIRMATION OF LINE SHAPE THEORY (Abstract), by L. Y. Chow, V. W. Hughes, and J. A. White. [1960] [1]p. [AF 18(600)1565] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 36, Jan. 27, 1960.

For a transition induced between 2 energy levels in an atomic beam experiment, the line shape as a function of the amplitude of the oscillating field has been calculated by Torrey and Salwen under the assumption that the atom is subjected to an oscillating field which is constant in amplitude and phase throughout the transition region. The magnetic field insensitive transition between the hyperfine levels $(F, m_F) = (3/2, -1/2)$ and $(1/2, -1/2)$ of the metastable $^3S_1$ state of He^3 at the field of 802.5 gauss which corresponds to the minimum transition frequency of 6354.2513 mc/sec has been chosen here to check the line shape theory. The constant amplitude and phase of the rf in the transition region have been achieved by use of a rectangular cavity operating in the TE_{101} mode. The measured values of line intensity and line width as a function of the rf amplitude agree with the theoretical values within the experimental errors of about 10%. The highest rf amplitude used is about 12 times the value which corresponds to the maximum transition probability.

3028

Yale U. [Sloane Physics Lab.] New Haven, Conn.

MAGNETO-OPTICAL EFFECTS IN CADMIUM SULFIDE (Abstract), by R. G. Wheeler and J. O. Dimmock. [1960] [1]p. [AF 49(638)503] Unclassified

Presented at meeting of the Amer. Phys. Soc., Detroit, Mich., Mar. 21-24, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 178, Mar. 21, 1960.

Additional Zeeman structure of the exciton lines and possible magneto-absorption structure has been observed in cadmium sulfide. The measurements were made at 1.8°K on crystals approximately 0.7 μ thick, thus extending the absorption spectrum to 4790A. Plane polarized light, E ⊥ C axis, was used for magnetic fields up to 19.7 kilogauss with orientations H ⊥ C and H ∥ C. Three additional lines at 4814, 4813, and 4806A were observed to split in the field. The splittings are as follows: 4814A, two components $g_\perp = 1.8$, one component $g_\parallel < 0.5$; 4813A two components $g_\perp = 2.6$, four components $g_\parallel = 1.7$; 4806 six components $g_\perp = 4.2$, one component $g_\parallel < 2.0$. These lines also exhibited substantial diamagnetic shifts to higher energy in the magnetic field. Also there was observed at high magnetic fields in the region of 4805 to 4790A, a series of absorption lines whose energy increased linearly with field. These lines were only observable in the H ∥ C orientation since, in the H ⊥ C orientation, the six Zeeman components of the 4806A exciton line with superposed diamagnetic shift masks the observation of magnetoabsorption lines. A preliminary identification and interpretation of the magnetoabsorption indicates a band edge at approximately 20805 cm^{-1} and a reduced effective mass of $0.068 \pm 0.004\ m_e$.

3029

Yale U. [Sloane Physics Lab.] New Haven, Conn.

OBSERVATION OF THE HYPERFINE STRUCTURE SPLITTING OF MUONIUM BY USE OF A STATIC MAGNETIC FIELD, by R. Prepost, V. W. Hughes, and K. Ziock. [1960] [3]p. incl. diagrs. (AFOSR-3266) (In cooperation with Columbia U., New York) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)545], Atomic Energy Commission, and Office of Naval Research) AD 252306 Unclassified

Also published in Phys. Rev. Ltrs., v. 6: 19-21, Jan. 1, 1961.

The discovery of muonium through the observation of its characteristic Larmor precession frequency may make possible a precision measurement of the hyperfine structure interval $\Delta\nu$ in the ground $1\ ^2S_{\frac{1}{2}}$ state of muonium in a microwave experiment. As a preliminary to such an experiment in order to obtain a rough measurement of $\Delta\nu$ and to confirm further the expected behavior of muonium, the effect of a static magnetic field on the polarization of muons has to be studied. The results indicate that $\Delta\nu = 4500$ mc/sec and that all the muons form muonium.

3030

Yale U. [Sloane Physics Lab.] New Haven, Conn.

ATOMIC PROCESSES FOR MU-MESIC HELIUM (Abstract), by V. W. Hughes, D. [W.] McColm and others. [1960] [1]p. (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)545], Atomic Energy Commission, and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 75, Jan. 27, 1960.

Many atomic processes involving mu-mesic helium must be considered for the understanding of the experiments reported (item nos. 3031 and 3032, Vol. IV) on the stopping of μ mesons in liquid helium. The primary experimental results are: (1) the low polarization of μ-mesons decaying in liquid helium and (2) the absence of the polarized atom $He^+\ \mu^-$. The second result is understandable because of the very high probability of an Auger transition and because of the low binding energy of an electron to $He^{++}\ \mu^-$ as compared to the binding

energy of an electron in He. The primary point of interest for the first result is the relatively low polarization of μ^- in liquid helium as compared with other targets with zero nuclear spin. This observation proves that a Z-independent depolarization mechanism involving only the spin-orbit interaction and radiative transitions is insufficient for an understanding of the depolarization. Effects dependent on Z which may influence the depolarization include: (1) atomic state into which μ^- is captured, (2) Auger transitions, and (3) collisions causing transitions between atomic states.

3031

Yale U. [Sloane Physics Lab.] New Haven, Conn.

DEPOLARIZATION OF NEGATIVE MUONS IN LIQUID HELIUM (Abstract), by R. Prepost, V. W. Hughes and others. [1960] [1]p. (In cooperation with Columbia U., New York) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)545], Atomic Energy Commission, and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 75, Jan. 27, 1960.

The depolarization of negative muons stopped in liquid helium has been measured in an experiment similar to that of Garwin, Lederman, and Weinrich. The target, which contained 1.7 g/cm^2 of helium, was made from copper, stainless steel, and brass. The lifetime of negative muons in the target materials is between 100 and 200 mμsec, and since no counts were accepted for the first 400 mμsec, the muon background from the target walls was low. The peak and valley gated electrons were counted in an electron telescope consisting of 2 counters placed at 90° to the incident muon beam. The ratio of the number of events for the cases of the target filled with liquid helium and the target empty was 3.56. The observed ratio of peak to valley counts was 1.03 ± 0.02. After corrections for background, finite gate width, and solid angle are made, the asymmetry coefficient for μ^- mesons decaying in liquid helium is 0.024 ± 0.01. For comparison the observed ratio of peak to valley counts for μ^- mesons stopping in carbon was 1.09 ± 0.013 and the asymmetry coefficient is 0.054 ± 0.006. The errors indicated are standard deviations due to counting statistics.

3032

Yale U. [Sloane Physics Lab.] New Haven, Conn.

SEARCH FOR $He^+ \mu^-$-ATOM (Abstract), by D. W. McColm, V. W. Hughes and others. [1960] [1]p. (In cooperation with Columbia U., New York) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)545], Atomic Energy Commission, and Office of Naval Research) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 75, Jan. 27, 1960.

A search has been made for the formation of the atom $He^+ \mu^-$ when negative muons are stopped in liquid helium, using the apparatus described in the previous abstract (item no. 3031, Vol. IV). In a magnetic field perpendicular to the muon beam direction, the total magnetic moment of the F = 1, M = ± 1 (M = magnetic quantum number with respect to muon beam direction) states of $He^+ \mu^-$ will precess with a frequency of 1.4 mc/sec-gauss. In a magnetic field of 3.9 gauss, a search for this precession was made by observation of the time distribution of the decay electrons with time-to-pulse height and pulse height analyzer circuits. The data were Fourier analyzed with the aid of an IBM 650 computer. No precession signal was observed, whereas a precession amplitude which was 2% of the total counting rate would have been detected.

3033

Yale U. [Sloane Physics Lab.] New Haven, Conn.

FORMATION OF MUONIUM AND OBSERVATION OF ITS LARMOR PRECESSION, by V. W. Hughes, D. W. McColm and others. [1960] [3]p. incl. diagrs. refs. (In cooperation with Columbia U., New York) (Sponsored jointly by Air Force Office of Scientific Research under AF 49-(638)545, Atomic Energy Commission, and Office of Naval Research) Unclassified

Published in Phys. Rev. Ltrs., v. 5: 63-65, July 15, 1960.

The formation of muonium in pure argon gas is reported. Muonium is also observed through its characteristic Larmor precession frequency. The argon gas was contained in a stainless steel cylinder at a pressure of 50 atm and was purified by recirculation over titanium sponge heated to 500°C. First, the depolarization of the muons stopped in the gas was measured in a free-muon precession experiment. The value of the ratio of the asymmetry parameter, a, for argon to that for carbon was 0.08 ± 0.15, and thus within the accuracy of the experiment no free polarized muons remain in argon. The resonances are clearly seen at the frequencies which are predicted for muonium precession on the basis of the magnetic field measurements. The data indicate that close to 100% of the muons form muonium in argon.

3034

Yale U. [Sloane Physics Lab.] New Haven, Conn.

ATOMIC gJ VALUES FOR NEON AND ARGON IN THEIR METASTABLE $^3P_2$ STATES; EVIDENCE FOR

ZERO SPIN OF $_{10}Ne^{20}$, by A. Lurio, G. Weinrich and others. [1960] [5]p. incl. diagrs. tables, refs. [AF 49-(638)545] AD 249318 Unclassified

Also published in Phys. Rev., v. 120: 153-157, Oct. 1, 1960.

The gyromagnetic ratios of neon and argon in their metastable $^3P_2$ states have been measured by the atomic beam magnetic resonance method. The results are $g_J(Ne, {}^3P_2) = 1.500888 \pm 0.00000.5$ and $g_J(A, {}^3P_2) = 1.500964 \pm 0.000008$, in agreement with the less precise optical spectroscopic measurements. Theoretical values, including radiative and relativistic effects, are $g_J(Ne, {}^3P_2) = 1.50088$ and $g_J(A, {}^3P_2) = 1.50095$, in good agreement with the experimental values. In addition, the Zeeman transition frequency for neon has been measured as a function of magnetic field to obtain evidence that the magnetic moment of Ne^{20} is less than 4×10^{-4} nuclear magneton and hence that the spin of Ne^{20} is probably zero. (Contractor's abstract)

3035

Yale U. Sterling Chemistry Lab., New Haven, Conn.

THE EPOXIDATION OF SOME ALLYLIC ALCOHOLS, by J. English, Jr. and M. L. Sassiver. 1960, 22p. incl. diagrs. tables, refs. (AFOSR-TN-60-247) (AF 49-(638)37) AD 233601; PB 147228 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 82: 4891-4895, Sept. 20, 1960.

Compounds in which R was methyl, ethyl, isopropyl, or tert-butyl were synthesized by the reaction of the appropriate aldehyde with vinylmagnesium chloride or bromide. The alkylvinyl carbinols were epoxidized with an excess of monoperphthalic acid in ether to give mixtures of threo- and erythro-1,2-epoxy-3-alkyl-3-propanols. An experiment was conducted to determine the effect, if any, of the losses of epoxide mixtures on the erythro-threo isomer ratio in the final diols. The results indicated that destruction of epoxides at this stage is not stereoselective, and that the ratios of diols observed represent those produced during epoxidation. The speculation is made that the per-acid may be involved with the hydroxyl group in the formation of an intermediate prior to epoxidation, since a degree of stereo specificity was observed with the allylic alcohols examined and not with 3,4-dimethyl-1-pentene. The suggestion is made that the interaction between the per-acid molecule and the hydroxyl group favors the threo-producing intermediate rather than an erythro-producing conformation.

3036

Yale U. Sterling Chemistry Lab., New Haven, Conn.

THE CLEAVAGE REACTION OF 1,3-DIOLS. IV, by T. E. Maggio and J. English, Jr. [1960] [23]p. incl. diagrs. tables, refs. (AFOSR-TN-60-879) (AF 49(638)37) AD 241437 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 83: 968-974, Feb. 20, 1961.

Cis- and trans-1-phenyl-2-methyl-2-(α-hydroxyisopropyl)-cyclopentanol and cis- and trans-1-phenyl-2-methyl-2-(α-hydroxyisopropyl)-cyclohexanol has been synthesized by a cleavage reaction which is influenced by the geometry of the 1,3 diol system. The assumption has been made that the requirements for a planar arrangement involving elimination which is trans- with respect to the incipient double bond controls the cause of the cleavage.

3037

Yeshiva U. Graduate School of Mathematical Sciences, New York.

NONEQUILIBRIUM DISTRIBUTION FUNCTIONS IN A FLUID, by J. L. Lebowitz, H. L. Frisch, and E. Helfand. [1960] [52]p. incl. refs. (AFOSR-TN-60-219) (AF 49-(638)753) Unclassified

Also published in Phys. Fluids, v. 3: 325-338, May-June 1960.

The behavior of a nonequilibrium fluid is analyzed on a level intermediate between that of hydrodynamics, where microstructure is totally ignored, and a phase space description, where the complete N-body problem must be solved. The study of the fluid at this level generally involves solving an appropriate transport equation. For liquids, the primary subject of this investigation, the Fokker-Planck equation of Kirkwood is accepted as a working model and solutions are found by the methods of Chapman and Enskog and of Grad to terms linear in deviations from local equilibrium. (It is argued, however, for a different form of the pair space force than that suggested by Kirkwood and co-workers) The results are similar in form to distributions found with other kinetic models. Variational principles are also considered. It is shown that the 1- and 2-particle distribution functions have the property of maximizing the entropy subject to the constraints of given densities and fluxes. Alternatively, these distributions maximize the entropy plus entropy productions in appropriate characteristic times. These variational principles do not depend on the use of the Fokker-Planck equation but appear to possess general validity. (Contractor's abstract)

3038

Yeshiva U. [Graduate School of Mathematical Sciences] New York.

GENERALIZED ENTROPY PRINCIPLE FOR NON-EQUILIBRIUM PROCESSES (Abstract), by J. L. Lebowitz, E. Helfand, and H. L. Frisch. [1960] [1]p. (AFOSR-TN-60-220) (AF 49(638)753) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 275, Apr. 25, 1960.

It was shown by Gibbs that the canonical distribution maximizes the entropy of a system represented by a Γ-space ensemble. He also showed separately that this distribution is a stationary solution of the dynamical problem, i.e., the Liouville equation. This permitted Gibbs to identify the canonical ensemble with equilibrium systems which identification has proven capable of predicting all the properties of equilibrium systems. The authors believe that they have found a generalization of this principle which holds also for systems that are slightly out of equilibrium (linear transport processes). The quantity R whose maximization yield the desired distribution is the sum of the systems entropy and the entropy produced by the transport processes during the past history of the system. This entropy production is related to the change in entropy of the heat baths with which the system is in contact. R thus may be considered as the entropy of the system plus its surroundings with respect to a suitably chosen reference level.

3039

Yeshiva U. [Graduate School of Mathematical Sciences] New York.

LOCAL EQUILIBRIUM DISTRIBUTION FUNCTIONS (Abstract), by H. L. Frisch and J. L. Lebowitz. [1960] [1]p. (AFOSR-TN-60-221) (AF 49(638)753) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 25-28, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 275, Apr. 25, 1960.

The form of the radial distribution function, g, in a system with non-uniform temperature, represented by a local equilibrium ensemble, is investigated. For an open system, represented by a grand ensemble, g (r_{12}) is equal to its value in an equilibrium system at the temperature and density of the midpoint between the molecules 1 and 2 to terms linear in the gradients. For a system with a fixed number of particles the requirement that g be an intensive quantity leads to a relation between the asymptotic values of the 3-particle and 4-particle equilibrium distributions. This relation is explicitly shown to be satisfied to first-order terms in the density. Some other results about these asymptotic values are also established.

3040

Yeshiva U. Graduate School of Mathematical Sciences, New York.

SCALED PARTICLE THEORY OF FLUIDS, by J. L. Lebowitz, E. Helfand and others. [1960] [31]p. incl. diagrs. (AFOSR-TN-60-222) (AF 49(638)753) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington. D. C., Apr. 25-28, 1960.

Abstract published in Bull. Amer. Phys. Soc., Series II, v. 5: 276, Apr. 25, 1960.

Also published in Jour. Chem. Phys., v. 33: 1379-1385, Nov. 1960.

A statistical thermodynamic theory has been developed employing distance scaling as a coupling procedure. This is an extension to real fluids of the technique applied by Reiss, Frisch, and Lebowitz to rigid sphere systems. One considers molecules interacting with pair potential u(r), except for one particle which interacts with potential $u(r/\lambda)$. This single particle, essentially a scaled version of a normal molecule, is termed a λ-cule. It is convenient to restrict discussion to potentials with rigid cores at r = a and cutoffs at γa. Attention is focused on a function, $\Theta(\lambda, p, T)$, which reduces to G in the case of rigid spheres. The pressure, chemical potential, and work of expanding a λ-cule are simply related to Θ. One can write Θ exactly for $\lambda < 1/2\gamma$ and simple connection conditions hold at $= 1/2\gamma$. An integral condition and $\lambda = \infty$ condition on Θ also exist. While Θ is not completely specified, the foregoing conditions determine much of its behavior. (Contractor's abstract)

3041

Yeshiva U. Graduate School of Mathematical Sciences, New York.

ASYMPTOTIC VALUE OF THE PAIR DISTRIBUTION NEAR A WALL, by J. L. Lebowitz. [1959] [5]p. incl. refs. (AFOSR-TN-50-537) (AF 49(638)753) AD 241257 Unclassified

Also published in Phys. Fluids, v. 3: 64-68, Jan.-Feb. 1960.

A calculation is made of the asymptotic value of the pair probability density $\rho_2(r_2, r_1)$ for finding a fluid particle at a point r_2 far in the interior of a fluid, when it is known that there is a particle at r_1 in contact with the

walls (rigid) of the container. This value is different from the well-known expression for the asymptotic value of $\rho_2(r_2, r_1)$ when both r_2 and r_1 are in the interior of the fluid. Derivation is based on the virial theorem for total momentum fluctuations in an equilibrium system and makes use of the assumption that there are no long range correlations in a fluid. Application is made of the result to re-derive simply the expression for the second virial coefficient and the exact equation of state of a hard-sphere gas in one dimension. Quantum systems are also treated. (Contractor's abstract)

3042

Yeshiva U. Graduate School of Mathematical Sciences, New York.

ASYMPTOTIC FORM OF EQUILIBRIUM DISTRIBUTION FUNCTIONS IN A FLUID AND PROPERTIES OF LOCAL-EQUILIBRIUM ENSEMBLES, by J. L. Lebowitz and J. K. Percus. [1960] 30p. (AFOSR-TN-60-813) (AF 49(638)753) AD 252730 Unclassified

The asymptotic form is obtained, i.e., the (1/N) dependence, for the joint distribution of (q + 1) molecules when the set of q molecules is very far from the set of 1 in an equilibrium fluid consisting of N molecules in volume V. When q + 1 is equal to 2, this expression reduces to that familiar from the Ornstein-Zernike relations for light scattering. For a uniform fluid, the complete (1/N) dependence of equilibrium distributions are also found. The result on the asymptotic form is then used to determine the low order distribution functions for an equilibrium system of varying density, as well as for a non-equilibrium system represented by a local equilibrium ensemble. The distribution functions are shown to be governed by the temperature and density in the vicinity of the molecules considered. It is found as expected that the 2-body distribution function coincides, to within quadratic terms in the gradients, with its equilibrium value for a uniform system at the temperature and density of the midpoint. For the higher order distributions, correction terms are linear in the gradients. (Contractor's abstract)

3043

Yeshiva U. Graduate School of Mathematical Sciences, New York.

THEORY OF THE TWO- AND ONE-DIMENSIONAL RIGID SPHERE FLUIDS, by E. Helfand, H. L. Frisch, and J. L. Lebowitz. [1960] [29]p. incl. diagr. refs. (AFOSR-TN-60-1343) (In cooperation with Bell Telephone Labs., Inc., Murray Hill, N. J.) (AF 49(638)753) PB 155280 Unclassified

Also published in Jour. Chem. Phys., v. 34: 1037-1042, Mar. 1961.

The approximate theory of the three-dimensional hard sphere fluid developed by Reiss, Frisch and Lebowitz has given astonishingly good predictions with little labor. In an attempt to investigate the reason for this result, further evidence for the internal consistency of the approximations of this theory is cited. It is noted that the same equation of state of hard sphere fluid is obtained when one used the "integral condition" as when the "infinity condition" is used. The theory to study the thermodynamic properties, in particular the equation of state, of the rigid sphere fluid in two and one dimensions has been applied. The approximate equation of state of the two-dimensional rigid sphere fluid is in good agreement over the range of fluid densities with the results of the machine Monte Carlo calculations by Jacobson and Wood and dynamical machine calculations of Wainwright and Alder. The exact Tonks' equation of state of the one-dimensional rigid sphere fluid is derived in a particularly simple manner.

3044

Yeshiva U. [Graduate School of Mathematical Sciences] New York.

SINGLET AND PAIR DISTRIBUTIONS IN A FLUID (Abstract), by J. L. Lebowitz and H. L. Frisch. [1960] [1]p. [AF 49(638)753] Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, Jan. 27-30, 1960.

Published in Bull. Amer. Phys. Soc., Series II, v. 5: 8, Jan. 27, 1960.

The solution of the Fokker-Planck equation suggested by Kirkwood for distribution functions in a liquid was investigated. Both the Chapman-Enskog and the Grad moment method of approximation was used and it was found that they yield identical results for the one particle distribution when the deviation from local equilibrium is expressed in terms of the stress and the heat flux. The distribution has then just the form of Grad's solution of the Boltzmann equation. This distribution maximizes the entropy subject to the requirement that the local hydrodynamic variables have certain specified values. Alternatively when expressed in terms of the strain and the temperature gradient the distribution maximizes a combination of the entropy and entropy production. The two particle distribution was found by the Chapman-Enskog method. This distribution too results (at least for the case of pure heat flux) from an N-particle distribution which maximizes the entropy subject to constraints on the combination of entropy and entropy production.

3045

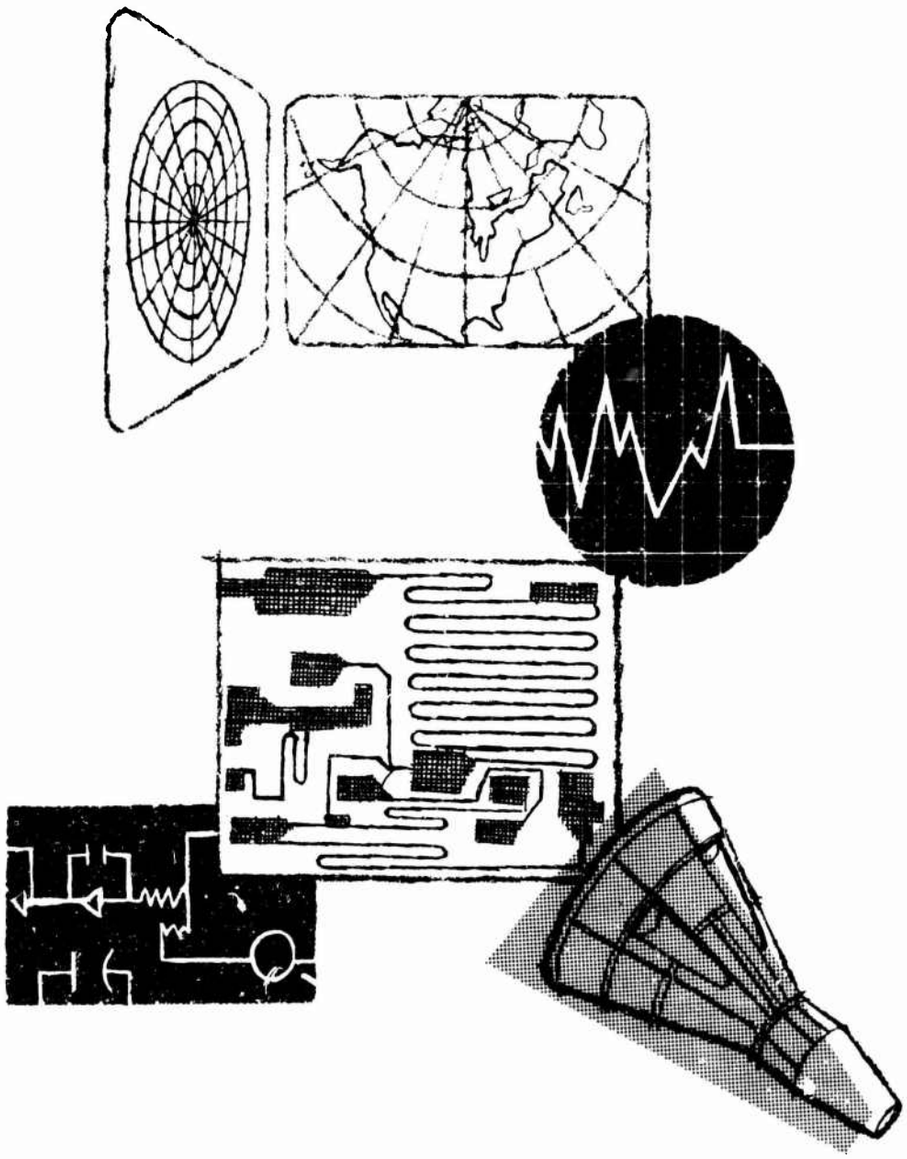
Yeshiva U. [Graduate School of Mathematical Sciences] New York.

LONG-RANGE CORRELATIONS IN A CLOSED SYSTEM

WITH APPLICATIONS TO NONUNIFORM FLUIDS, by J. L. Lebowitz and J. K. Percus. [1960] [17]p. (In cooperation with New York U., N. Y.) (Sponsored jointly by Air Force Office of Scientific Research under [AF 49(638)753] and Atomic Energy Commission)
Unclassified

Published in Phys. Rev., v. 122: 1675-1691, June 15, 1961.

The way in which the assumption of the existence of a finite correlation length in a fluid yields explicit expressions for the (1/N) terms in the joint distribution of 2 sets of particles which are far apart compared to the correlation length was demonstrated. The form of these terms was then utilized to prove the local nature of the low order distributions in a system with spatially varying intensive parameters. It appears that the central problem in the theory of equilibrium fluids is the proof of the existence of such a length. This is related to the distinction between fluids and crystals and hence to phase transitions between these forms. (Contractor's abstract)



3046

Zator Co., Cambridge, Mass.

THE "TAPE TYPEWRITER PLAN." A METHOD FOR COOPERATION IN DOCUMENTATION, by C. N. Mooers. July 1960, 22p. (Rept. no. ZTB-137) (AFOSR-TN-60-532) (AF 49(638)376) AD 239984 Unclassified

Also published in Asllb. Proc., v. 12: 277-291, Aug. 1960.

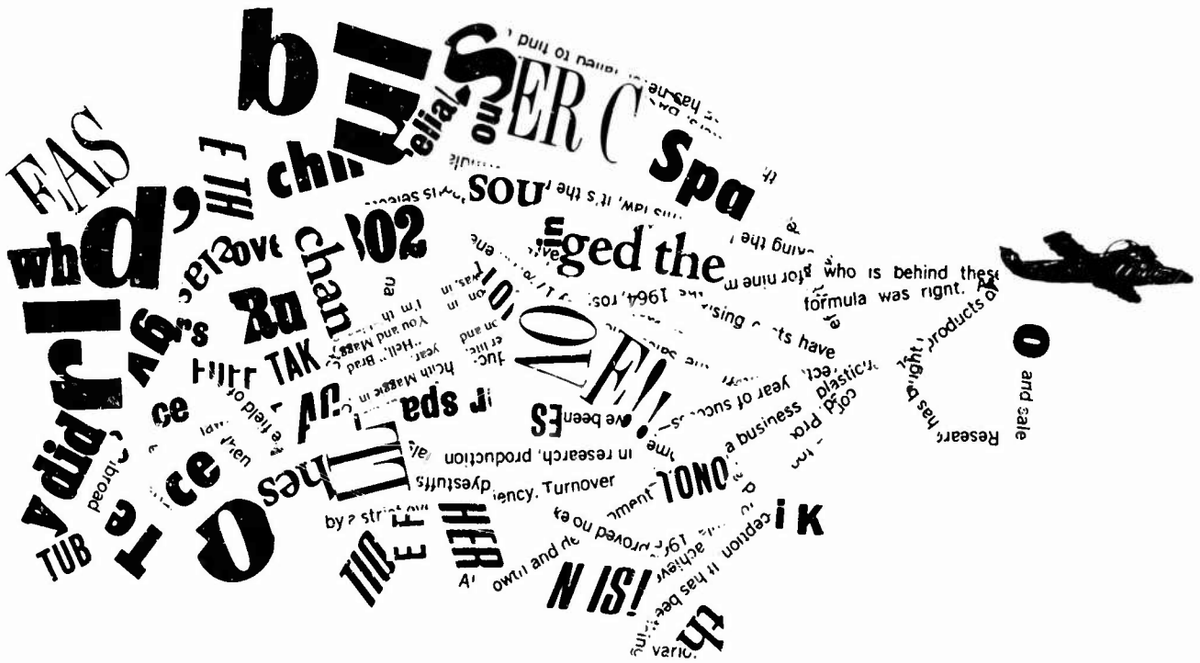
The tape typewriter plan is a plan for cooperation in documentation between libraries, while facilitating the internal clerical and cataloging operations at individual libraries. The plan is based upon the use of a tape-controlled typewriter and the associated use of the full capabilities of modern information processing machines (electronic computers and their related devices). Any individual library requires only a tape typewriter in order to enter the plan and to become a full cooperator. By the exchange of tapes between libraries, the duplication of bibliographic work at cooperating libraries can be markedly reduced. Conformity to any single classification system or to any specific catalog card format is not required by the plan, since the information processing machines can make new tapes for other formats, and can perform translations from one classification system to another. The information processing machines can also be used for rapid compilation of special indices, lists, etc., for the documentary resources of all the cooperating libraries. Important aspects are that it does not require setting up a unique large-scale universal documentation center for processing, search, or storage; it does not require conformity in the choice of tape typewriter equipment, it does not require library ownership of computing equipment; nor does it depend upon any specific choice of computing equipment. The plan is shown to be self-motivating, with participation at each library following from the library's own assessment of its self interest. (Contractor's abstract)

3047

Zator Co., Cambridge, Mass.

A PRELIMINARY REPORT ON A GENERAL THEORY OF INDUCTIVE INFERENCE, by R. J. Solomonoff. Nov. 1960. 26p. (Rept. no. ZTB-138) (AFOSR-TN-60-1459) (AF 49(638)376) AD 252445 Unclassified

Some preliminary work is presented on a new general theory of inductive inference. The extrapolation of an ordered sequence of symbols is implemented by computing the a priori probabilities of various sequences of symbols. The a priori probability of a sequence is obtained by considering a universal Turing machine whose output is the sequence in question. An approximation to the a priori probability is given by the shortest input to the machine that will give the desired output. A more exact formulation is given, and it is made somewhat plausible that extrapolation probabilities obtained will be largely independent of just which universal Turing machine was used, providing that the sequence to be extrapolated has an adequate amount of information in it. Some examples are worked out to show the application of the method to specific problems. Applications of the method to curve fitting and other continuous problems are discussed to some extent. (Contractor's abstract)



Contract Index

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North Carolina U. Inst. of Statistics, Chapel Hill
1850, 1851

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2228

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1038-1041

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1798

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2899, 2900

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Illinois U. Engineering Experiment Station, Urbana
924, 925

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1852, 1853

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Chicago U. Lab. of Molecular Structure and Spectra, Ill.
468-473

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Oklahoma State U. Dept. of Chemistry, Stillwater
1939

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Oklahoma State U. Dept. of Chemistry, Stillwater
1940

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Minnesota U. School of Chemistry, Minneapolis
1702, 1703

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Wayne State U. Dept. of Chemistry, Detroit, Mich.
2915-2919

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Miami U., Oxford, Ohio
1592

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1094

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Duke U. Microwave Lab., Durham, N. C.
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1230

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475

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882

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444-454

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2021, 2022

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Cornell U. Dept. of Physics, Ithaca, N. Y.
567-570

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571-573

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523

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649

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566

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3025

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Ohio State U. Research Foundation. Dept. of Physics and Astronomy, Columbus
1920-1929

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Brown U. Div. of Engineering, Providence, R. I.
171-174

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Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge
1319

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Rutgers U. Dept. of Physics, New Brunswick, N. J.
2442

Contract Index

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Ohio State U. Research Foundation. Dept. of Electrical Engineering, Columbus
1916

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Ohio State U. Research Foundation. Dept. of Electrical Engineering, Columbus
1917

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565

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1820

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Maryland U. Dept. of Physics, College Park
1179-1181

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Missouri U. Dept. of Mathematics, Columbia
1728, 1729

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California Inst. of Tech. Antenna Lab., Pasadena
199

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Pennsylvania U. Dept. of Mathematics, Philadelphia
2072

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California U. Dept. of Mathematics, Berkeley
237

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2999

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Carnegie Inst. of Tech. Dept. of Mathematics, Pittsburgh, Pa.
395

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Columbia U. Dept. of Chemistry, New York
499

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Pennsylvania U. Dept. of Mathematics, Philadelphia
2073

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Polytechnic Inst. of Brooklyn, N. Y.
2140, 2141

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1692, 1693

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2701

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1232-1244

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2873, 2874

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2245, 2246

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Columbia U. Columbia Radiation Lab., New York
488-490

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Duke U. Dept. of Mathematics, Durham, N. C.
614-619

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Princeton U. Dept. of Mathematics, N. J.
2229, 2230

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Chicago U. Dept. of Mathematics, Ill.
428-431

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Alfred U. New York State U. Coll. of Ceramics, N. Y.
49

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Harvard U. Dept. of Mathematics, Cambridge, Mass.
757, 758

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Detroit U. Research Inst. of Science and Engineering, Mich.
600-602

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1895

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Temple U. Research Inst., Philadelphia, Pa.
2741

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2273-2275

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1704

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2231, 2232

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965-970

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Atlantic Research Corp., Alexandria, Va.
68

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2158-2184

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Stanford U. Biophysics Lab., Calif.
2513-2517

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2901-2903

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729-735

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1022-1024

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Princeton U. Dept. of Aeronautical Engineering, N. J.
2203-2206

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2397, 2398

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Eastern Research Group, Brooklyn, N. Y.
644

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Illinois U. Dept. of Chemistry, Urbana
863, 864

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Catholic U. of America. Dept. of Chemistry, Washington, D. C.
408-411

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Washington U. Dept. of Chemistry, Seattle
2904-2906

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2470-2472

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Ohio State U. Research Foundation. Dept. of Chemistry, Columbus
1911, 1912

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Johns Hopkins U. Lab. of Astrophysics and Physical Meteorology, Baltimore, Md.
1063

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California Inst. of Tech. Mechanical Engineering Lab., Pasadena
216

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Yale U. Sloane Physics Lab., New Haven, Conn.
3026, 3027

AF 18(600)1567
Alabama U., University
45-48

AF 18(600)1570
California U. Inst. of Engineering Research, Berkeley
299, 300

AF 18(600)1572
Carnegie Inst. of Tech. Metals Research Lab., Pittsburgh, Pa.
399

AF 18(600)1573
Central State Coll., Wilberforce, Ohio
423

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Purdue U. Dept. of Physics, Lafayette, Ind.
2296-2303

Contract Index

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Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.
678-683

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Maryland U. Dept. of Physics, College Park
1187 1188

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Pensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.
2343-2347

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Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.
2319-2323

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Rutgers U. Dept. of Mathematics, New Brunswick, N. J.
2438-2441

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Northwestern U. Dept. of Metallurgy and Materials Science, Evanston, Ill.
1896-1899

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.
555-557

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California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena
203-211

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Rutgers U. Dept. of Physics, New Brunswick, N. J.
2443-2445

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Michigan U. Engineering Research Inst., Ann Arbor
1625-1627

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Chicago U. Chicago Midway Labs., Ill.
424

AF 18(603)10
Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
542-545

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Yale U. Dept. of Physics, New Haven, Conn.
3010-3020

AF 18(603)17
Minnesota U. School of Chemistry, Minneapolis
1705-1709

AF 18(603)18
Minnesota U. Hormel Inst., Minneapolis
1696

AF 18(603)19
Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
546

AF 18(603)20
Syracuse U. Dept. of Psychology, N. Y.
2697

AF 18(603)22
Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana
869, 870

AF 18(603)25
New York U. Coll. of Engineering, N. Y.
1779, 1780

AF 18(603)26
Arkansas U. Dept. of Physics, Fayetteville
63

AF 18(603)30
Minnesota U., Minneapolis
1671-1673

AF 18(603)33
North American Philips Co., Inc. Philips Labs., Irvington-on-Hudson, N. Y.
1834

AF 18(603)34
Michigan U. Engineering Research Inst., Ann Arbor
1628

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Pennsylvania State U. X-Ray and Crystal Analysis Lab., University Park
2057-2070

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Washington U. Dept. of Physics, Seattle
2910

AF 18(603)38
North Carolina U. Dept. of Mathematics, Chapel Hill
1842

AF 18(603)40
Oklahoma State U., Stillwater
1938

AF 18(603)41
Johns Hopkins U. Dept. of Mathematics, Baltimore, Md
1026-1032

AF 18(603)43
South Carolina U. Dept. of Electrical Engineering, Columbia
2467-2469

AF 18(603)45
Purdue U. Dept. of Chemistry, Lafayette, Ind.
2283-2286

AF 18(603)48
Mount Zion Hospital, San Francisco, Calif.
1731-1735

AF 18(603)49
Illinois U. Dept. of Physics, Urbana
883-885

AF 18(603)50
Syracuse U. Dept. of Physics, N. Y.
2683, 2684

AF 18(603)53
Stanford U. Radio Propagation Lab., Calif.
2610-2620

AF 18(603)54
Brown U. Dept. of Physics, Providence, R. I.
155-161

AF 18(603)58
Yale U. Dept. of Mathematics, New Haven, Conn.
3000

AF 18(603)61
Western Reserve U. Dept. of Physics, Cleveland, Ohio
2965, 2966

AF 18(603)62
Illinois U. Electrical Engineering Research Lab., Urbana
902-907

AF 18(603)65
Pennsylvania U. Dept. of Mathematics, Philadelphia
2074-2077

AF 18(603)79
Baylor U. Coll. of Medicine, Houston, Tex.
96, 97

AF 18(603)81
Rochester U. School of Medicine and Dentistry, N. Y.
2417

AF 18(603)84
Massachusetts Inst. of Tech. Dept. of Physics, Cambridge
1326-1328

AF 18(603)87
Brown U. Metcalf Research Lab., Providence, R. I.
133, 184

AF 18(603)90
Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge
1300-1302

AF 18(603)91
Massachusetts Inst. of Tech., Cambridge
1293-1296

AF 18(603)93
Indiana U. Dept. of Chemistry, Bloomington
926

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Southern California U. Engineering Center, Los Angeles
2478-2489

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North American Aviation, Inc. Rocketdyne Div., Canoga Park, Calif.
1830

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Utah U. Dept. of Metallurgy, Salt Lake City
2830-2833

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Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.
2185-2190

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Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana
871, 872

AF 18(603)107
Sundstrand Machine Tool Co. Sundstrand Turbo Div., Rockford, Ill.
2662, 2663

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Washington U. Dept. of Physics, St. Louis, Mo.
2875-2891

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Aerojet-General Corp., Azusa, Calif.
11-15

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.
558

AF 18(603)112
Minnesota U. Dept. of Aeronautical Engineering, Minneapolis
1677-1679

AF 18(603)113
Minnesota U., Minneapolis
1674, 1675

AF 18(603)114
Massachusetts U. Dept. of Chemistry, Amherst
1568

AF 18(603)121
Illinois Inst. of Tech. Armour Research Foundation, Chicago
835-837

Contract Index

AF 18(603)126
Stanford U. Stanford Electronics Labs., Calif.
2621-2631

AF 18(603)127
Fordham U. Dept. of Chemistry, New York
672-674

AF 18(603)131
Stanford U. Dept. of Physics, Calif.
2532-2538

AF 18(603)135
Oklahoma State U. Dept. of Chemistry, Stillwater
1941, 1942

AF 18(603)137
Illinois U. Dept. of Chemistry, Urbana
865

AF 18(603)139
Purdue Research Foundation, Lafayette, Ind.
2276-2282

AF 18(603)140
Rutgers U. Dept. of Physics, New Brunswick, N. J.
2446, 2447

AF 18(603)141
Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
547-549

AF 18(603)142
Texas U. Dept. of Chemistry, Austin
2748, 2749

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Johns Hopkins U. Dept. of Physics, Baltimore, Md.
1042-1055

AF 19(604)7344
Massachusetts Inst. of Tech. National Magnet Lab., Cambridge
1409-1411

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Texas U. Dept. of Physics, Austin
2750

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Princeton U. James Forrestal Research Center, N. J.
2247

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1913-1915

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California U. Dept. of Chemistry, Berkeley
232-235

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Boston U. Dept. of Chemistry, Mass.
133

AF 49(638)4
California U. Minerals Research Lab., Berkeley
324, 325

AF 49(638)6
Brown U. Dept. of Physics, Providence, R. I.
162-168

AF 49(638)10
Michigan State U. Dept. of Physics and Astronomy, East Lansing
1594-1596

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Plasmadyne Corp. Giannini Research Lab., Santa Ana, Calif.
2129

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2920-2922

AF 49(638)15
Fairchild Engine and Airplane Corp. Fairchild Engine Div., Deer Park, N. Y.
647

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Rutgers U. Coll. of Engineering, New Brunswick, N. J.
2437

AF 49(638)20
California U. Dept. of Engineering, Los Angeles
352-354

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California Inst. of Tech. Palomar Observatory, Pasadena
217-229

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Virginia U. Research Labs. for the Engineering Sciences, Charlottesville
2855

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Rensselaer Polytechnic Inst. Dept. of Aeronautical Engineering, Troy, N. Y.
2323-2332

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Maryland U. Dept. of Physics, College Park
1189-1210

AF 49(638)25
Aerojet-General Corp., Azusa, Calif.
16

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Brandeis U. Dept. of Physics, Waltham, Mass.
137-141

AF 49(638)28
Utah U. Inst. for the Study of Rate Processes, Salt Lake City
2826

AF 49(638)29
Harvard U. Cruft Lab., Cambridge, Mass.
739, 740

AF 49(638)31
Brown U. Metcalf Research Lab., Providence, R. I.
185, 186

AF 49(638)32
Princeton U. Chemical Engineering Lab., N. J.
2192-2202

AF 49(638)33
New Mexico U., Albuquerque
1771-1775

AF 49(638)34
New Mexico U. Dept. of Physics, Albuquerque
1777

AF 49(638)35
Texas U. Dept. of Physics, Austin
2751-2753

AF 49(638)37
Yale U. Sterling Chemistry Lab., New Haven, Conn.
3035, 3036

AF 49(638)39
Illinois Inst. of Tech. Dept. of Chemistry, Chicago
848, 849

AF 49(638)41
Oklahoma U. Dept. of Physics, Norman
1943-1947

AF 49(638)42
Massachusetts Inst. of Tech. Dept. of Mathematics Cambridge
1303-1312

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Iowa State U. of Science and Tech. Statistical Lab., Ames
971, 972

AF 49(638)46
Brown U. Div. of Engineering, Providence, R. I.
175-178

AF 49(638)48
Kentucky U. Dept. of Chemistry, Lexington
1087, 1088

AF 49(638)50

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.
2333-2337

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Rochester U. Dept. of Physics and Astronomy, N. Y.
2400-2402

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Plasmadyne Corp. Giannini Research Lab., Santa Ana, Calif.
2130

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California U. Minerals Research Lab., Berkeley
326, 327

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Purdue U. Dept. of Chemistry, Lafayette, Ind.
2287-2289

AF 49(638)61
Avco Corp. Avco-Everett Research Lab., Everett, Mass.
74-79

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Illinois U. Electrical Engineering Research Lab., Urbana
908-922

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Minnesota U. Dept. of Mathematics, Minneapolis
1683

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Midwest Research Inst., Kansas City, Mo.
1647

AF 49(638)67
Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.
2338, 2339

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Michigan U. Willow Run Labs., Ann Arbor
1639-1646

AF 49(638)70
Michigan State U. Dept. of Physics and Astronomy, East Lansing
1597

AF 49(638)72
Virginia U. Dept. of Mathematics, Charlottesville
2844-2851

Contract Index

AF 49(638)76
Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge
1313

AF 49(638)78
Rice U. Dept. of Mechanical Engineering, Houston, Tex.
2396

AF 49(638)79
California U. Dept. of Mathematics, Berkeley
238-241

AF 49(638)83
California U. Minerals Research Lab., Berkeley
328-330

AF 49(638)86
Pennsylvania State U. Dept. of Chemistry, University Park
2013-2015

AF 49(638)87
Alfred U. New York State U. Coll. of Ceramics, N. Y.
50, 51

AF 49(638)88
South Carolina U. Dept. of Chemistry, Columbia
2466

AF 49(638)89
Stanford Research Inst., Menlo Park, Calif.
2494-2496

AF 49(638)90
Kentucky U. Dept. of Physics, Lexington
1089-1092

AF 49(638)91
Documentation, Inc., Washington, D. C.
605

AF 49(638)92
Washington U. Dept. of Physics, Seattle
2911-2914

AF 49(638)95
Massachusetts Inst. of Tech. Dept. of Physics, Cambridge
1330

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Miami U. Dept. of Physics, Coral Gables, Fla.
1588-1591

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Massachusetts General Hospital. Neurophysiological Lab., Boston
1280-1292

AF 49(638)99
Chicago U. Dept. of Psychology, Ill.
440

AF 49(638)100
Colorado U. Dept. of Mathematics, Boulder
477-479

AF 49(638)102
California U. Electronics Research Lab., Berkeley
292-298

AF 49(638)104
Michigan U. Dept. of Mathematics, Ann Arbor
1617

AF 49(638)105
California U. Dept. of Chemistry, Berkeley
236

AF 49(638)107
Wayne State U. Dept. of Mathematics, Detroit, Mich.
2923, 2924

AF 49(638)113
Illinois Inst. of Tech. Armour Research Foundation, Chicago
838-840

AF 49(638)153
Yale U. Dept. of Mathematics, New Haven, Conn.
3001-3006

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Stevens Inst. of Tech. Dept. of Physics, Hoboken, N. J.
2650-2656

AF 49(638)158
Wayne State U. Dept. of Physics, Detroit, Mich.
2930-2934

AF 49(638)159
Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.
684

AF 49(638)160
Massachusetts Inst. of Tech. Aeroelastic and Structures Research Lab., Cambridge
1298, 1299

AF 49(638)160
Massachusetts Inst. of Tech. Fluid Dynamics Research Group, Cambridge
1332-1335

AF 49(638)161
New York U. Inst. of Mathematical Sciences, N. Y.
1799-1806

AF 49(638)162
Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.
685, 686

AF 49(638)165
Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.
2163, 2164

AF 49(638)166
California U. Inst. of Engineering Research, Berkeley
301-309

AF 49(638)167
Brown U. Metcalf Research Lab., Providence, R. I.
187

AF 49(638)168
Kent State U. Dept. of Physics, Ohio
1082-1086

AF 49(638)169
New York U. Dept. of Chemistry, N. Y.
1781-1784

AF 49(638)170
Utah U. Dept. of Chemical Engineering, Salt Lake City
2824

AF 49(638)172
Puerto Rico U. Dept. of Electrical Engineering, Mayaguez
2271, 2272

AF 49(638)173
New York U., N. Y.
1776

AF 49(638)176
Virginia U. Dept. of Physics, Charlottesville
2852-2854

AF 49(638)178
Aerojet-General Corp., Azusa, Calif.
17-19

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Wayne State U. Dept. of Mathematics, Detroit, Mich.
2925-2929

AF 49(638)190
Minnesota U. Rosemount Aeronautical Lab., Minneapolis
1699-1701

AF 49(638)191
Cornell U. Dept. of Chemistry, Ithaca, N. Y.
559

AF 49(638)195
New York U. Dept. of Sociology, N. Y.
1794-1797

AF 49(638)201
Stanford U. Dept. of Mechanical Engineering, Calif.
2530

AF 49(638)207
Massachusetts Inst. of Tech. Fluid Dynamics Research Group, Cambridge
1336-1340

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.
455-458

AF 49(638)213
North Carolina U. Inst. of Statistics, Chapel Hill
1854-1870

AF 49(638)212
Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana
873

AF 49(638)214
Aerojet-General Corp., Azusa, Calif.
20-23

AF 49(638)217
Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.
2142-2145

AF 49(638)218
Washington U. Dept. of Mathematics, St. Louis, Mo.
2865-2872

AF 49(638)220
California Inst. of Tech. Guggenheim Aeronautical Lab., Pasadena
200

AF 49(638)222
Battelle Memorial Inst., Columbus, Ohio
85-91

AF 49(638)223
Stanford U. Dept. of Aeronautical Engineering, Calif.
2518-2526

AF 49(638)224
Yale U. Dept. of Mathematics, New Haven, Conn.
3007

AF 49(638)227
Carnegie Inst. of Tech. Dept. of Mathematics, Pittsburgh, Pa.
396, 297

AF 49(638)228
Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park
1245-1260

AF 49(638)229
New York U. Inst. of Mathematical Sciences, N. Y.
1807-1810

Contract Index

AF 49(638)230
Cornell U. Sibley School of Mechanical Engineering, Ithaca, N. Y.
596

AF 49(638)232
Brown U. Div. of Applied Mathematics, Providence, R. I.
169, 170

AF 49(638)234
Massachusetts Inst. of Tech., Cambridge
1297

AF 49(638)237
Carnegie Inst. of Tech. Dept. of Civil Engineering, Pittsburgh, Pa.
394

AF 49(638)241
Colorado U. Dept. of Chemistry, Boulder
476

AF 49(638)242
Illinois U. Dept. of Clinical Science, Urbana
866

AF 49(638)243
General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio
710, 711

AF 49(638)245
Massachusetts Inst. of Tech. Naval Supersonic Lab., Cambridge
1412-1419

AF 49(638)247
McMaster U. Hamilton Coll., Ont. (Canada)
1138-1141

AF 49(638)248
Johns Hopkins U. Dept. of Mechanics, Baltimore, Md.
1033, 1034

AF 49(638)249
Toronto U. Inst. of Aerophysics (Canada)
2769-2771

AF 49(638)250
North American Aviation, Inc. Missile Div., Downey, Calif.
1829

AF 49(638)252
Aerojet-General Corp., Azusa, Calif.
24

AF 49(638)253
Institute for Advanced Study, Princeton, N. J.
933-949

AF 49(638)255
Aeronautical Research Associates of Princeton, Inc., N. J.
33, 34

AF 49(638)256
Human Sciences Research, Inc., Arlington, Va.
829-831

AF 49(638)257
Carnegie Inst. of Tech., Pittsburgh, Pa.
393

AF 49(638)259
New York U. Physics Dept., N. Y.
1821, 1822

AF 49(638)260
Bell Aerospace Corp. Bell Aerosystems Co., Buffalo, N. Y.
103

AF 49(638)261
North Carolina U. Inst. of Statistics, Chapel Hill
1871-1874

AF 49(638)262
Minnesota U. Inst. of Tech., Minneapolis
1697, 1698

AF 49(638)264
Ohio State U. Research Foundation. Dept. of Physics and Astronomy, Columbus
1930-1932

AF 49(638)265
Syracuse U. Dept. of Mathematics
2668-2673

AF 49(638)269
Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
550-553

AF 49(638)278
Florida State U. Dept. of Chemistry, Tallahassee
650-652

AF 49(638)279
Cornell U. Dept. of Chemistry, Ithaca, N. Y.
560-563

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Toronto U. Inst. of Aerophysics (Canada)
2772-2774

AF 49(638)282
Wisconsin U. Dept. of Chemistry, Madison
2985-2988

AF 49(638)285
Wisconsin U. Dept. of Chemistry, Madison
2989-2992

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Alfred U. New York State U. Coll. of Ceramics, N. Y.
52-55

AF 49(636)269
Massachusetts Inst. of Tech. Dynamic Analysis Control Lab., Cambridge
1331

AF 49(638)290
San Andres U. Laboratorio de Fisica Cosmica de Chacaltaya, La Paz (Bolivia)
2455-2462

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Stanford U. Applied Mathematics and Statistics Lab., Calif.
2505-2506

AF 49(636)297
Purdue U. Dept. of Chemistry, Lafayette, Ind.
2290

AF 49(636)299
California U. Dept. of Physics, Berkeley
251

AF 49(638)300
AeroChem Research Labs., Inc., Princeton, N. J.
5-10

AF 49(636)301
General Dynamics Corp. General Atomic Div., San Diego, Calif.
706-709

AF 49(636)302
Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.
2146-2151

AF 49(636)303
Rochester U. Dept. of Physics and Astronomy, N. Y.
2403-2406

AF 49(636)304
Princeton U. Palmer Physical Lab., N. J.
2254-2270

AF 49(636)305
Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.
2759-2761

AF 49(636)309
Southern California U. Dept. of Chemistry, Los Angeles
2473, 2474

AF 49(636)311
Aeronutronic, Newport Beach, Calif.
40

AF 49(638)312
New Hampshire U. Dept. of Chemistry, Durham
1766-1766

AF 49(638)313
Indiana U. Dept. of Chemistry, Bloomington
927

AF 49(636)314
Wisconsin U. Dept. of Bacteriology, Madison
2962-2984

AF 49(636)315
Northwestern U. Dept. of Chemistry, Evanston, Ill.
1662-1664

AF 49(638)317
Ohio State U. Research Foundation. Dept. of Psychology, Columbus
1933, 1934

AF 49(636)316
Indiana U. Dept. of Chemistry, Bloomington
926-932

AF 49(636)321
Northwestern U. Dept. of Medicine, Chicago, Ill.
1693, 1694

AF 49(636)323
Pittsburgh U. Sarah Mellon Scaife Radiation Lab., Pa.
2121-2127

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Purdue U. Dept. of Chemistry, Lafayette, Ind.
2291

AF 49(636)325
George Washington U. Dept. of Chemistry, Washington, D. C.
724

AF 49(636)327
California U. Dept. of Physics, Berkeley
252-266

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Florida U. Engineering and Industrial Experiment Station, Gainesville
671

AF 49(638)333
North Carolina U. Dept. of Chemistry, Chapel Hill
1639-1641

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Plasmadyne Corp. Giannini Research Lab., Santa Ana, Calif.
2131-2133

AF 49(638)336
Michigan U. Dept. of Aeronautical and Astronautical Engineering, Ann Arbor
1604

Contract Index

AF 49(638)339
California U. Dept. of Physics, Berkeley
269-274

AF 49(638)341
New York U. Inst. of Mathematical Sciences, N. Y.
1811-1816

AF 49(638)342
Stanford U. Microwave Lab., Calif.
2595

AF 49(638)346
Illinois Inst. of Tech. Dept. of Chemistry, Chicago
850

AF 49(638)350
Columbia U. Dept. of Electrical Engineering, New York
507, 508

AF 49(638)351
North American Aviation, Inc. Rocketdyne Div.,
Canoga Park, Calif.
1831, 1832

AF 49(638)353
Stanford Research Inst., Menlo Park, Calif.
2497-2498

AF 49(638)354
Duke U. Medical Center, Durham, N. C.
620-624

AF 49(638)355
Bolt, Beranek and Newman, Inc., Cambridge, Mass.
131, 132

AF 49(638)357
Western Reserve U. School of Library Science,
Cleveland, Ohio
2967-2974

AF 49(638)361
Case Inst. of Tech. Statistical Lab., Cleveland, Ohio
404-407

AF 49(638)362
Ohio State U. Research Foundation. Dept. of
Mathematics, Columbus
1919

AF 49(638)364
National Research Council, Washington, D. C.
1761

AF 49(638)367
Michigan U. Research Center for Group Dynamics,
Ann Arbor
1629-1634

AF 49(638)369
Michigan U. Dept. of Electrical Engineering,
Ann Arbor
1614, 1615

AF 49(638)371
Illinois U. Dept. of Psychology, Urbana
898-901

AF 49(638)373
Ohio State U. Research Foundation. Dept. of
Psychology, Columbus
1935, 1936

AF 49(638)375
Massachusetts Inst. of Tech. Dept. of Mechanical
Engineering, Cambridge
1320

AF 49(638)376
Zator Co., Cambridge, Mass.
3046, 3047

AF 49(638)378
Minnesota U. Dept. of Electrical Engineering,
Minneapolis
1680

AF 49(638)380
Bell Aircraft Corp., Buffalo, N. Y.
107

AF 49(638)381
Princeton U. Dept. of Psychology, N. J.
2243, 2244

AF 49(638)382
RIAS, Inc., Baltimore, Md.
2361-2390

AF 49(638)383
Northwestern U. Dept. of Mathematics, Evanston, Ill.
1886-1890

AF 49(638)384
Baylor U. Coll. of Medicine, Houston, Tex.
98-102

AF 49(638)385
Maryland U. Inst. for Fluid Dynamics and Applied
Mathematics, College Park
1261

AF 49(638)388
Stanford U. Dept. of Physics, Calif.
2539-2565

AF 49(638)389
Midwest Research Inst., Kansas City, Mo.
1648

AF 49(638)391
Chicago U. Dept. of Mathematics, Ill.
432

AF 49(638)398
California U. Dept. of Mathematics, Berkeley
242-246

AF 49(638)399
Maryland U. Dept. of Physics, College Park
1211-1220

AF 49(638)401
Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park
1262-1275

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Cornell U. Dept. of Physics, Ithaca, N. Y.
574

AF 49(638)408
Columbia U. School of Engineering, New York
525

AF 49(638)409
Drexel Inst. of Tech. Lab. of Climatology, Centerton, N. J.
606-610

AF 49(638)411
Princeton U. Dept. of Aeronautical Engineering, N. J.
2207-2209

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Lockheed Aircraft Corp. Missiles and Space Div., Palo Alto, Calif.
1104

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Chicago U. Committee on Mathematical Biology, Ill.
425-427

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Stanford U. Microwave Lab., Calif.
2596-2598

AF 49(638)416
Pennsylvania State U. Groth Inst., University Park
2027-2056

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National Research Council, Washington, D. C.
1762

AF 49(638)420
Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana
874-879

AF 49(638)421
Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge
1420

AF 49(638)422
Michigan U. Dept. of Chemical and Metallurgical Engineering, Ann Arbor
1607, 1608

AF 49(638)423
Johns Hopkins U. Dept. of Mechanics, Baltimore, Md.
1035, 1036

AF 49(638)424
Ohio State U. Research Foundation, Dept. of Electrical Engineering, Columbus
1918

AF 49(638)425
Illinois Inst. of Tech. Dept. of Metallurgical Engineering, Chicago
851-855

AF 49(638)427
Florida State U. Dept. of Physics, Tallahassee
655-670

AF 49(638)430
Columbia U. Inst. of Air Flight Structures, New York
524, 524A

AF 49(638)431
Princeton U. Dept. of Mathematics, N. J.
2233, 2234

AF 49(638)432
Rochester U. Inst. of Optics, N. Y.
2413-2415

AF 49(638)433
Rochester U. Inst. of Optics, N. Y.
2416

AF 49(638)435
Pennsylvania U. Dept. of Metallurgical Engineering, Philadelphia
2079, 2080

AF 49(638)436
Northwestern U. Dept. of Metallurgy and Materials Science, Evanston, Ill.
1900

AF 49(638)438
California U. Dept. of Engineering, Los Angeles
355-365

AF 49(638)439
Michigan U. Dept. of Physics, Ann Arbor
1621-1623

AF 49(638)440
Washington U. Dept. of Aeronautical Engineering, Seattle
2898

AF 49(638)441
Battelle Memorial Inst., Columbus, Ohio
92, 93

AF 49(638)443
Western Reserve U. School of Medicine, Cleveland, Ohio
2975

Contract Index

AF 49(638)444
Brown U. Div. of Engineering, Providence, R. I.
179-181

AF 49(638)445
Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.
2152-2162

AF 49(638)446
New York U. Inst. of Mathematical Sciences, N. Y.
1817-1819

AF 49(638)447
Ohio State U. Research Foundation. Dept. of Psychology, Columbus
1937

AF 49(638)450
Brown U. Metals Research Lab., Providence, R. I.
182

AF 49(638)451
Chicago U. Dept. of Mathematics, Ill.
433-435

AF 49(638)452
Catholic U. of America. Dept. of Physics, Washington, D. C.
417-422

AF 49(638)453
Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.
2165-2167

AF 49(638)454
Pennsylvania U. Dept. of Physics, Philadelphia
2081-2086

AF 49(638)456
Pittsburgh U. Dept. of Chemistry, Pa.
2120

AF 49(638)457
Pennsylvania State U. Dept. of Chemistry, University Park
2016, 2017

AF 49(638)459
Georgia Inst. of Tech. Engineering Experiment Station, Atlanta
736

AF 49(638)460
Texas U. Dept. of Psychology, Austin
2755-2758

AF 49(638)461
Syracuse U. Dept. of Physics, N. Y.
2685-2687

AF 49(638)462
Utah U. Dept. of Electrical Engineering, Salt Lake City
2825-2829

AF 49(638)464
Washington U. Dept. of Physics, St. Louis, Mo.
2892-2896

AF 49(638)465
Princeton U. Dept. of Aeronautical Engineering, N. J.
2210-2224

AF 49(638)468
Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.
1025

AF 49(638)472
Kansas U. Dept. of Chemistry, Lawrence
1064

AF 49(638)474
De Paul U. Dept. of Chemistry, Chicago, Ill.
597-599

AF 49(638)475
Catholic U. of America. Dept. of Chemistry, Washington, D. C.
412-415

AF 49(638)477
Vitro Corp. of America. Vitro Labs., West Orange, N. J.
2856

AF 49(638)480
Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.
554

AF 49(638)482
Stanford U. Dept. of Chemistry, Calif.
2527-2529

AF 49(638)483
Atlantic Research Corp., Alexandria, Va.
69

AF 49(638)484
Cornell U. Dept. of Chemistry, Ithaca, N. Y.
564

AF 49(638)485
Minnesota U. School of Chemistry, Minneapolis
1710-1712

AF 49(638)486
Harvard U. Graduate School of Business Administration, Cambridge, Mass.
767, 768

AF 49(638)487
Georgetown U. Medical Center, Washington, D. C.
727, 728

AF 49(638)492
Michigan U. Speech Research Lab., Ann Arbor
1635-1838

AF 49(638)493
Michigan U. Dept. of Chemical and Metallurgical Engineering, Ann Arbor
1809-1611

AF 49(638)495
Battelle Memorial Inst., Columbus, Ohio
94, 95

AF 49(638)496
Johns Hopkins U. Dept. of Aeronautics, Baltimore, Md.
1021

AF 49(638)497
California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena
212

AF 49(638)498
California U. Dept. of Astronomy, Los Angeles
335-343

AF 49(638)501
New Mexico U., Albuquerque
1778

AF 49(638)502
California U. Inst. of Engineering Research, Berkeley
310, 311

AF 49(838)503
Yale U. Sloane Physics Lab., New Haven, Conn.
3028

AF 49(638)504
Pennsylvania State U. Field Emission Lab., University Park
2023-2036

AF 49(638)505
Purdue U. Dept. of Mathematics, Lafayette, Ind.
2294, 2295

AF 49(638)506
Nebraska U., Lincoln
1785

AF 49(638)508
California U. Dept. of Physics, Berkeley
275-278

AF 49(838)510
Atlantic Research Corp., Alexandria, Va.
70

AF 49(838)511
Michigan State U., East Lansing
1593

AF 49(838)512
Franklin Inst. Bartol Research Foundation, Philadelphia, Pa.
875-677

AF 49(638)513
Stanford U. Div. of Engineering Mechanics, Calif.
2568, 2587

AF 49(638)514
Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.
2348

AF 49(638)515
Yale U. Dept. of Mathematics, New Haven, Conn.
3008, 3009

AF 49(638)516
Catholic U. of America. Dept. of Mechanical and Aeronautical Engineering, Washington, D. C.
418

AF 49(838)517
Illinois U. Dept. of Mathematics, Urbana
887, 868

AF 49(638)518
Harvard U. Mallinckrodt Chemical Lab., Cambridge, Mass.
787-792

AF 49(638)519
Minnesota U. School of Chemistry, Minneapolis
1713

AF 49(638)520
Columbia U. Dept. of Chemistry, New York
500-504

AF 49(638)521
California Inst. of Tech. Guggenheim Aeronautical Lab., Pasadena
201, 202

AF 49(638)522
Southern California U. Dept. of Electrical Engineering, Los Angeles
2478, 2477

AF 49(638)524
Northwestern U. Dept. of Metallurgy and Materials Science, Evanston, Ill.
1901-1904

AF 49(638)525
Chicago U. Dept. of Mathematics, Ill.
436

AF 49(838)526
Minnesota U. Dept. of Mathematics, Minneapolis
1684, 1885

Contract Index

AF 49(638)527
Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.
2349, 2350

AF 49(638)529
Illinois U. Dept. of Physics, Urbana
886-888

AF 49(638)530
Maryland U. Dept. of Physics, College Park
1221-1228

AF 49(638)531
Purdue U. Dept. of Chemistry, Lafayette, Ind.
2292, 2293

AF 49(638)533
Princeton U. James Forrestal Research Center, N. J.
2248-2253

AF 49(638)534
Electrochemical Soc. Theoretical Electrochemistry Div., New York
646

AF 49(638)535
Johns Hopkins U. Dept. of Physics, Baltimore, Md.
1056

AF 49(638)537
Pennsylvania U. Dept. of Physics, Philadelphia
2087

AF 49(638)538
Michigan U. Dept. of Chemistry, Ann Arbor
1612, 1613

AF 49(638)540
Aerojet-General Corp., Azusa, Calif.
25, 26

AF 49(638)541
Mellon Inst. Dept. of Chemistry, Pittsburgh, Pa.
1579-1582

AF 49(638)542
Mellon Inst. Dept. of Chemistry, Pittsburgh, Pa.
1583-1585

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.
583-591

AF 49(638)545
Yale U. Sloane Physics Lab., New Haven, Conn.
3029-3034

AF 49(638)547
Arkansas U. Dept. of Physics, Fayetteville
64, 65

AF 49(638)548
Toronto U. Inst. of Aerophysics (Canada)
2775

AF 49(638)549
Human Sciences Research Inc., Arlington, Va.
832-834

AF 49(638)550
Stanford U. Div. of Engineering Mechanics, Calif.
2568

AF 49(638)552
Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.
2351-2360

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Northeastern U. Dept. of Physics, Boston, Mass.
1878-1880

AF 49(638)556
Illinois U. Electrical Engineering Research Lab., Urbana
923

AF 49(638)557
Columbia U. Columbia Radiation Lab., New York
491-496

AF 49(638)558
Minnesota U. Heat Transfer Lab., Minneapolis
1694, 1695

AF 49(638)559
Arkansas U. Dept. of Physics, Fayetteville
66

AF 49(638)560
Texas U. Dept. of Physics, Austin
2754

AF 49(638)562
Michigan U. Dept. of Aeronautical and Astronautical Engineering, Ann Arbor
1605, 1606

AF 49(638)563
North Carolina U. Dept. of Physics, Chapel Hill
1843-1848

AF 49(638)564
Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge
1321

AF 49(638)565
Stanford Research Inst. Poulter Labs., Menlo Park, Calif.
2501

AF 49(638)566
Aerojet-General Corp., Azusa, Calif.
27

AF 49(638)567
St. Louis U. Dept. of Physics, Mo.
2453

AF 49(638)569
Pennsylvania U. Dept. of Mathematics, Philadelphia
2078

AF 49(638)571
Syracuse U. Dept. of Mathematics, N. Y.
2674, 2675

AF 49(638)572
Materials Research Corp., Yonkers, N. Y.
1569

AF 49(638)573
Aerojet-General Corp., Azusa, Calif.
28

AF 49(638)574
Harvard U. Dept. of Mathematics, Cambridge, Mass.
759-765

AF 49(638)576
Illinois Inst. of Tech. Armour Research Foundation, Chicago
841

AF 49(638)577
Itek Corp., Boston, Mass.
1020

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Princeton U. Dept. of Mathematics, N. J.
2235-2238

AF 49(638)579
Illinois U. Dept. of Physics, Urbana
889-895

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Johns Hopkins U. Dept. of Medicine, Baltimore, Md.
1037

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St. Johns U. Dept. of Physics, Jamaica, N. Y.
2448-2451

AF 49(638)585
Instituto de Investigación de Ciencias Biológicas, Montevideo (Uruguay)
950-952

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New York U. Dept. of Electrical Engineering, N. Y.
1785-1793

AF 49(638)587
Princeton U. Dept. of Biology, N. J.
2225-2227

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Syracuse U. Research Inst. Dept. of Physics, N. Y.
2698-2700

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Harvard U. Lyman Lab. of Physics, Cambridge, Mass.
769-786

AF 49(638)590
Maryland U. Dept. of Mathematics, College Park
1174-1178

AF 49(638)591
Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.
2978, 2979

AF 49(638)592
General Dynamics Corp. Convair Div., Pomona, Calif.
704

AF 49(638)595
Brazil U. Inst. de Biofisica, Rio de Janeiro
148, 149

AF 49(638)597
Minneapolis-Honeywell Regulator Co., Hopkins, Minn.
1662

AF 49(638)598
Florida State U. Dept. of Mathematics, Tallahassee
654

AF 49(638)599
Westinghouse Electric Corp. Westinghouse Research Labs., Pittsburgh, Pa.
2980, 2981

AF 49(638)600
California U. Dept. of Physics, Berkeley
279

AF 49(638)601
California U. Materials Research Lab., Berkeley
321-323

AF 49(638)602
Rochester U. Dept. of Physics and Astronomy, N. Y.
2407-2411

AF 49(638)603
California U. Dept. of Mathematics, Berkeley
247

AF 49(638)604
California U. Dept. of Mathematics, Berkeley
248, 249

AF 49(638)607
Federation of American Societies for Experimental Biology, Washington, D. C.
648

Contract Index

AF 49(638)608
Connecticut U. Dept. of Mathematics, Storrs
530, 531

AF 49(638)611
Colorado U. Dept. of Physics, Boulder
480, 481

AF 49(638)612
St. Louis U. Dept. of Physics, Mo.
2454

AF 49(638)613
Michigan State U. Dept. of Physics and Astronomy, East Lansing
1598, 1599

AF 49(638)616
Washington State U. Dept. of Chemistry, Pullman
2857-2861

AF 49(638)617
Minnesota U. Dept. of Mathematics, Minneapolis
1686, 1687

AF 49(638)618
Illinois Inst. of Tech. Armour Research Foundation, Chicago
842, 843

AF 49(638)619
Syracuse U. Dept. of Mathematics, N. Y.
2676-2682

AF 49(638)620
North American Philips Co., Inc. Philips Labs., Irvington-on-Hudson, N. Y.
1835-1838

AF 49(638)621
Case Inst. of Tech. Dept. of Physics, Cleveland, Ohio
402, 403

AF 49(638)622
Michigan State U. Dept. of Physics and Astronomy, East Lansing
1600, 1601

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Georgia Inst. of Tech. Engineering Experiment Station, Atlanta
737

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Stanford Research Inst. Poulter Labs., Menlo Park, Calif.
2502-2504

AF 49(638)628
General Mills, Inc., Minneapolis, Minn.
720

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Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge
1322-1324

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Columbia U. Dept. of Physics, New York
510-513

AF 49(638)632
Rice U. Dept. of Mathematics, Houston, Tex.
2394, 2395

AF 49(638)633
Michigan U. Dept. of Mathematics, Ann Arbor
1618, 1619

AF 49(638)635
New York U. Physics Dept., N. Y.
1823-1825

AF 49(638)636
Brandeis U. Dept. of Physics, Waltham, Mass.
142-147

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Western Ontario U. Dept. of Physics, London (Canada)
2945-2964

AF 49(638)643
Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge
1325

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Columbia U. Dept. of Mathematics, New York
509

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Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park
1276-1279

AF 49(638)647
Pennsylvania State U. Dept. of Aeronautical Engineering, University Park
2011, 2012

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Pontifical Catholic U., Rio de Janeiro (Brazil)
2191

AF 49(638)649
North American Aviation, Inc. Rocketdyne Div., Canoga Park, Calif.
1833

AF 49(638)650
Texaco Experiment, Inc., Richmond, Va.
2742, 2743

AF 49(638)651
Atlantic Research Corp., Alexandria, Va.
71

AF 49(638)653
Arkansas U. Dept. of Chemistry, Fayetteville
61, 62

AF 49(638)655
Plasmadyne Corp., Santa Ana, Calif.
2128

AF 49(638)656
Aerojet-General Corp., Azusa, Calif.
29-31

AF 49(638)657
Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.
2762-2764

AF 49(638)658
Radio Corp. of America. Astro-Electronics Div., Princeton, N. J.
2311-2318

AF 49(638)659
Avco Corp. Avco-Everett Research Lab., Everett, Mass.
80-84

AF 49(638)666
Chicago U. Dept. of Mathematics, Ill.
437, 438

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California U. School of Public Health, Berkeley
331-333

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Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana
880

AF 49(638)673
Technical Research Group, Inc., New York
2702, 2703

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Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.
592, 593

AF 49(638)675
Boston U. Dept. of Physics, Mass.
134-136

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Iowa State U. of Science and Tech. Dept. of Chemistry, Ames
964

AF 49(638)679
Rochester U. Dept. of Chemistry, N. Y.
2399

AF 49(638)681
American Inst. for Research, Pittsburgh, Pa.
57-59

AF 49(638)683
Minnesota U. School of Chemistry, Minneapolis
1714-1716

AF 49(638)685
Pennsylvania U. School of Medicine, Philadelphia
2092-2101

AF 49(638)686
California U. Brain Research Inst., Los Angeles
334

AF 49(638)687
New Hampshire U. Dept. of Physics, Durham
1769, 1770

AF 49(638)689
Columbia U. Dept. of Physics, New York
514

AF 49(638)690
Yale U. Dept. of Physics, New Haven, Conn.
3021

AF 49(638)691
Wisconsin U. Dept. of Zoology, Madison
2994-2997

AF 49(638)692
Princeton U. Dept. of Mathematics, N. J.
2239-2241

AF 49(638)693
Chicago U. Dept. of Mathematics, Ill.
439

AF 49(638)694
Chicago U. Inst. for the Study of Metals, Ill.
463

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Wisconsin U. Dept. of Pharmacology, Madison
2993

AF 49(638)696
California Inst. of Tech., Pasadena
198

AF 49(638)705
Pennsylvania State U. Dept. of Engineering Mechanics, University Park
2018, 2019

AF 49(638)707
Ohio State U. Research Foundation, Columbus
1910

Contract Index

AF 49(638)708
Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge
1314-1317

AF 49(638)711
Minnesota U. School of Chemistry, Minneapolis
1717-1724

AF 49(638)712
Florida State U. Dept. of Chemistry, Tallahassee
653

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Harvard U. Medical School. Dept. of Pharmacology, Boston, Mass.
793

AF 49(638)714
Stanford U. Dept. of Medical Microbiology, Calif.
2531

AF 49(638)716
Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.
594

AF 49(638)717
California U. Dept. of Physics, Los Angeles
366-368

AF 49(638)719
California U. Dept. of Chemistry, Los Angeles
344, 345

AF 49(638)720
Minnesota U. School of Chemistry, Minneapolis
1725

AF 49(638)723
Washington U. Dept. of Chemistry, Seattle
2907-2909

AF 49(638)724
Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge
1421-1424

AF 49(638)726
Bryn Mawr Coll. Dept. of Psychology, Pa.
188

AF 49(638)728
Massachusetts Mental Health Center, Boston
1567

AF 49(638)729
North Carolina U. Psychometric Lab., Chapel Hill
1875-1877

AF 49(638)733
California U. Dept. of Chemistry, Los Angeles
346

AF 49(638)734
McMaster U. Hamilton Coll. (Canada)
1142, 1143

AF 49(638)735
RIAS, Inc., Baltimore, Md.
2391

AF 49(638)738
California U. Dept. of Mathematics, Berkeley
250

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Harvard U. School of Dental Medicine, Boston, Mass.
794

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Northwestern U. Dept. of Political Science, Evanston, Ill.
1906

AF 49(638)743
Columbia U. Dept. of Sociology, New York
515-522

AF 49(638)747
Minnesota U. Dept. of Electrical Engineering, Minneapolis
1681, 1682

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Cornell U. Lab. for Atomic and Solid State Physics, Ithaca, N. Y.
595

AF 49(638)749
Bell Aerospace Corp. Bell Aerosystems Co., Buffalo, N. Y.
104-106

AF 49(638)751
National Research Council, Washington, D. C.
1763

AF 49(638)752
Yale U. Dept. of Physics, New Haven, Conn.
3022-3024

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Yeshiva U. Graduate School of Mathematical Sciences, New York
3037-3045

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Missouri U. Dept. of Mathematics, Columbia
1730

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Purdue U. Jet Propulsion Center, Lafayette, Ind.
2307-2310

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California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena
213-215

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Litton Industries. Space Research Labs., Beverly Hills, Calif.
1100-1103

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Toronto U. Inst. of Aerophysics (Canada)
2776-2778

AF 49(638)764
Western Reserve U. School of Medicine, Cleveland, Ohio
2976, 2977

AF 49(638)765
Duke U. Microwave Lab., Durham, N. C.
642, 643

AF 49(638)766
Plasmadyne Corp. Giannini Research Lab., Santa Ana, Calif.
2134

AF 49(638)767
Purdue U. Dept. of Physics, Lafayette, Ind.
2304-2306

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Michigan U. Engineering Psychology Group, Ann Arbor
1624

AF 49(638)770
Carnegie Inst. of Tech. Dept. of Psychology, Pittsburgh, Pa.
398

AF 49(638)773
Case Inst. of Tech. Dept. of Chemistry, Cleveland, Ohio
400, 401

AF 49(638)774
Michigan U. Dept. of Mathematics, Ann Arbor
1620

AF 49(638)776
British Columbia U. Dept of Mathematics, Vancouver (Canada)
150-153

AF 49(638)780
Northwestern U. Dept. of Metallurgy and Materials Science, Evanston, Ill.
1905

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Illinois U. Dept. of Physics, Urbana
896

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Texas Technological Coll. Dept. of Chemistry, Lubbock
2747

AF 49(638)791
General Electric Co. General Electric Research Lab., Schenectady, N. Y.
712

AF 49(638)794
California U. Dept. of Psychology, Santa Barbara
369

AF 49(638)799
Utah U. Dept. of Physics, Salt Lake City
2834, 2835

AF 49(638)801
Syracuse U. Dept. of Physics, N. Y.
2688-2696

AF 49(638)802
Chicago U. Inst. for the Study of Metals, Ill.
464-467

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Minnesota U., Minneapolis
1676

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Georgia U. Dept. of Sociology, Athens
738

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Washington State U. Dept. of Psychology, Pullman
2862-2864

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Harvard U. Dept. of Chemistry, Cambridge, Mass.
754-756

AF 49(638)811
Minnesota U. School of Physics, Minneapolis
1726, 1727

AF 49(638)813
Atlantic Research Corp., Alexandria, Va.
72, 73

AF 49(638)814
General Electric Co. Space Sciences Lab., Philadelphia, Pa.
714, 715

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Cincinnati U. Dept. of Chemistry, Ohio
474

AF 49(638)826
Pennsylvania State U. Dept. of Mathematics, University Park
2020

Contract Index

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Southern California U. Dept. of Chemistry, Los Angeles
2475

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Illinois Inst. of Tech. Armour Research Foundation, Chicago
844-846

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Southern California U. Engineering Center, Los Angeles
2490-2493

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Wayne State U. Dept. of Physics, Detroit, Mich.
2935

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Washington U. Dept. of Physics, St. Louis, Mo.
2897

AF 49(638)839
Allied Research Associates, Inc., Boston, Mass.
56

AF 49(638)842
Sydney U. School of Physics (Australia)
2664-2667

AF 49(638)845
Harvard U. Dept. of Mathematics, Cambridge, Mass.
766

AF 49(638)847
Illinois Inst. of Tech. Armour Research Foundation, Chicago
847

AF 49(638)851
Aerojet-General Corp., Azusa, Calif.
32

AF 49(638)855
General Dynamics Corp. Convair Div., Pomona, Calif.
705

AF 49(638)857
Minnesota U. Dept. of Mathematics, Minneapolis
1688, 1689

AF 49(638)860
Manitoba U. Dept. of Mathematics (Canada)
1149

AF 49(638)862
Miami U. Dept. of Mathematics, Coral Gables, Fla.
1586, 1587

AF 49(638)865
North Carolina U. Dept. of Physics, Chapel Hill
1849

AF 49(638)869
Combustion Inst., Pittsburgh, Pa.
526, 527

AF 49(638)877
Northwestern U. Dept. of Mathematics, Evanston, Ill.
1891

AF 49(638)880
Illinois U. Dept. of Mining and Metallurgical Engineering, Urbana
881

AF 49(638)884
Michigan U. Dept. of Electrical Engineering, Ann Arbor
1616

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Minnesota U. Dept. of Mathematics, Minneapolis
1690

AF 49(638)886
Thompson Ramo-Wooldridge, Inc. Ramo-Wooldridge Div., Los Angeles, Calif.
2765, 2766

AF 49(638)888
Northwestern U. Dept. of Mathematics, Evanston, Ill.
1892

AF 49(638)889
Oregon U. Dept. of Mathematics, Eugene
1948-1950

AF 49(638)894
Michigan State U. Dept. of Physics and Astronomy, East Lansing
1602, 1603

AF 49(638)896
Illinois U. Dept. of Physics, Urbana
897

AF 49(638)897
Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.
2340, 2341

AF 49(638)899
Maryland U. Dept. of Physics, College Park
1229

AF 49(638)901
California U. Dept. of Chemistry, Los Angeles
347-351

AF 49(638)908
Minneapolis-Honeywell Regulator Co., Hopkins, Minn.
1663-1670

AF 49(638)910
California Inst. of Tech. Seismological Lab., Pasadena
230

AF 49(638)914
General Electric Co. Space Sciences Lab., Philadelphia, Pa.
716, 717

AF 49(638)919
Princeton U. Dept. of Mathematics, N. J.
2242

AF 49(638)925
Chicago U. Dept. of Psychology, Ill.
441-443

AF 49(638)926
General Electric Co. General Electric Research Lab., Schenectady, N. Y.
713

AF 49(638)928
Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.
2342

AF 49(638)931
General Electric Co. Space Sciences Lab., Philadelphia, Pa.
718, 719

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Massachusetts Inst. of Tech. Fluid Dynamics Research Group, Cambridge
1341

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Northwestern U. Dept. of Chemistry, Evanston, Ill.
1885

AF 49(638)936
Columbia U. Columbia Radiation Lab., New York
497, 498

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Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge
1318

AF 49(638)947
RIAS, Inc., Baltimore, Md.
2392

AF 49(638)951
Pennsylvania U. Office of Computer Research and Education, Philadelphia
2088-2091

AF 49(638)953
Columbia U. Dept. of Chemistry, New York
505, 506

AF 49(638)953
Columbia U. Dept. of Chemistry, New York
505, 506

AF 49(638)983
American Inst. of Physics, Inc., New York
60

AF 49(638)1009
Lehigh U. Dept. of Mathematics, Bethlehem, Pa.
1095

AF 49(638)1017
RIAS, Inc., Baltimore, Md.
2393

AF 61(052)04
Hebrew U. Dept. of Mathematics, Jerusalem (Israel)
795

AF 61(052)10
Technion - Israel Inst. of Tech., Haifa
2704

AF 61(052)13
Uppsala U. Inst. of Physics (Sweden)
2811-2822

AF 61(052)15
Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden)
1066-1070

AF 61(052)16
Leyden U. Lorentz Inst. (Netherlands)
1096

AF 61(052)20
Marseille U. (France)
1171

AF 61(052)21
Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden)
1071-1073

AF 61(052)23
Milan U. Lab. of Physiology (Italy)
1658-1661

AF 61(052)30
Bern U. Brain Research Inst., Waldau-Bern (Switzerland)
108-127

AF 61(052)38
Rome U. Dept. of Pharmacology (Italy)
2418

AF 61(052)40
Uppsala U. Inst. of Chemistry (Sweden)
2794-2803

AF 61(052)42
Aarhus U. Mathematical Inst. (Denmark)
1-3

Contract Index

AF 61(052)43
Uppsala U. Inst. of Chemistry (Sweden)
2804-2810

AF 61(052)46
Lund U. Thermochemistry Lab. (Sweden)
1136, 1137

AF 61(052)49
Oslo U. Inst. of Theoretical Physics (Norway)
1956-1959

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Cambridge U. Cavendish Lab. (Gt. Brit.)
371-375

AF 61(052)51
Paris U. (France)
2001, 2002

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Hebrew U. Dept. of Physics, Jerusalem (Israel)
803-817

AF 61(052)61
London U. Dept. of Chemsitry (Gt. Brit.)
1107, 1108

AF 61(052)62
Hull U. Dept. of Chemistry (Gt. Brit.)
822-828

AF 61(052)71
Oslo U. Inst. of Chemistry (Norway)
1951-1955

AF 61(052)72
Norway Technical U. Inst. for Theoretical Chemistry, Trondheim
1907-1909

AF 61(052)73
Copenhagen U. Dept. of Chemistry (Denmark)
532-536

AF 61(052)75
Aeronautical Research Inst. of Sweden, Stockholm
35-39

AF 61(052)78
Technische Hochschule, Vienna (Austria)
2739

AF 61(052)80
Istituto Nazionale di Ottica, Florence (Italy)
994-1015

AF 61(052)83
Milan U. (Italy)
1649-1651

AF 61(052)86
Liège U. Brussels (Belgium)
1097-1099

AF 61(052)95
Marseille U. (France)
1172, 1173

AF 61(052)96
Naples U. Inst. of Theoretical Physics (Italy)
1742-1745

AF 61(052)97
Cambridge U. Dept. of Zoology (Gt. Brit.)
389, 390

AF 61(052)98
Cambridge U. Cavendish Lab. (Gt. Brit.)
376

AF 61(052)103
Marey Inst., Paris (France)
1150-1170

AF 61(052)106
Lund U. Dept. of Pharmacology (Sweden)
1117-1121

AF 61(052)107
Pisa U. Inst. of Physiology (Italy)
2103-2119

AF 61(052)116
Lund U. Dept. of Physics (Sweden)
1132-1135

AF 61(052)118
Nobel Inst. of Physics, Stockholm (Sweden)
1826-1828

AF 61(052)119
Karolinska Inst. Nobel Inst. for Neurophysiology, Stockholm (Sweden)
1077-1080

AF 61(052)121
Israel Inst. of Applied Social Research, Jerusalem
973-978

AF 61(052)123
Technion - Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa
2711, 2712

AF 61(052)124
Méditerranéen de Recherches Thermodynamiques, Nice (France)
1576, 1577

AF 61(052)144
Politecnico di Milano. Laboratorio di Elettrochimica, Chimica Fisica, e Metallurgia (Italy)
2135

AF 61(052)158
Societe Francaise d'Etudes et de Realisations d'Inventions Coanda, Clichy (France)
2465

AF 61(052)160
Naples U. Inst. of Aeronautics (Italy)
1736-1741

AF 61(052)162
Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden)
2425-2432

AF 61(052)163
Dublin Inst. for Advanced Studies (Ireland)
612

AF 61(052)173
Paris U. Lab. de Physique Théorique et Hautes Energies (France)
2004-2009

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Free U. of Brussels. Dept. of Chemical Physics (Belgium)
692-698

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Oxford U. Dept. of Biochemistry (Gt. Brit.)
1973-1984

AF 61(052)183
Uppsala U. Gustaf Werner Inst. for Nuclear Chemistry (Sweden)
2793

AF 61(052)185
Cambridge U. Psychological Lab. (Gt. Brit.)
391, 392

AF 61(052)187
Hebrew U. Dept. of Mathematics, Jerusalem (Israel)
796-802

AF 61(052)188
Istituto Superiore di Sanita, Rome (Italy)
1016-1019

AF 61(052)192
Technion - Israel Inst. of Tech. Dept. of Mathematics, Haifa
2715

AF 61(052)193
Madrid U. Dept. of Crystallography (Spain)
1144-1148

AF 61(052)194
Technion - Israel Inst. of Tech., Haifa
2705, 2706

AF 61(052)198
Rome U. School of Aeronautical Engineering (Italy)
2419

AF 61(052)208
Politecnico di Torino. Laboratorio di Meccanica Applicata (Italy)
2136-2139

AF 61(052)211
Trieste U. Inst. of Physics (Italy)
2783, 2784

AF 61(052)214
Technische Hochschule, Vienna (Austria)
2740

AF 61(052)215
Küssner, H. G.,Goettingen (Germany)
1093

AF 61(052)217
Free U. of West Berlin (Germany)
699

AF 61(052)221
Instituto Nacional de Tecnica Aeronautica Esteban Terradas, Madrid (Spain)
960-963

AF 61(052)223
Technion - Israel Inst. of Tech., Haifa
2707-2709

AF 61(052)229
Henri-Rousselle Hospital, Paris (France)
821

AF 61(052)230
Turin U. (Italy)
2787

AF 61(052)233
Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.)
377-388

AF 61(052)235
Oxford U. Dept. of Pharmacology (Gt. Brit.)
1985-1989

AF 61(052)239
Free U. of West Berlin (Germany)
700

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Birmingham U. Dept. of Chemistry (Gt. Brit.)
128

AF 61(052)244
Technische Hochschule, Munich (Germany)
2731

AF 61(052)247
Lund U. Dept. of Pharmacology (Sweden)
1122-1131

Contract Index

AF 61(052)253
Siena U. Inst. of Pathology (Italy)
2463, 2464

AF 61(052)256
London U. Dept. of Anatomy (Gt. Brit.)
1105, 1106

AF 61(052)260
Milan U. (Italy)
1652-1655

AF 61(052)265
Vienna U. Inst. for Theoretical Physics (Austria)
2838-2843

AF 61(052)271
London U. Inst. of Laryngology and Otology (Gt. Brit.)
1110-1112

AF 61(052)276
Aberdeen U. Dept. of Chemistry (Scotland)
4

AF 61(052)277
Edinburgh U. Dept. of Pharmacology (Gt. Brit.)
645

AF 61(052)281
Technion - Israel Inst. of Tech., Haifa
2710

AF 61(052)285
Genoa U. (Italy)
721

AF 61(052)296
Méditerranéen de Recherches Thermodynamiques, Nice (France)
1578

AF 61(052)300
Stockholm U. Psychological Lab. (Sweden)
2657-2661

AF 61(052)307
Keele U., Staffordshire (Gt. Brit.)
1081

AF 61(052)309
Karolinska Inst. Dept. of Physiology, Stockholm (Sweden)
1074-1076

AF 61(052)320
London U. Queen Mary Coll. (Gt. Brit.)
1113

AF 61(052)324
Technion - Israel Inst. of Tech. Dept. of Mathematics, Haifa
2716

AF 61(052)328
Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy)
989-992

AF 61(052)331
Cambridge Language Research Unit (Gt. Brit.)
370

AF 61(052)333
Compagnie de Recherches et d'Etudes Aeronautiques, Paris (France)
528, 529

AF 61(052)335
Free U. of West Berlin (Germany)
701

AF 61(052)337
Weizmann Inst. of Science. Dept. of Physics, Rehovot (Israel)
2938-2944

AF 61(052)339
Technion - Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa
2713, 2714

AF 61(052)347
Hebrew U. Dept. of Physics, Jerusalem (Israel)
818, 819

AF 61(052)348
Royal Inst. of Tech. Div. of Gasdynamics, Stockholm (Sweden)
2433-2436

AF 61(052)352
Weizmann Inst. of Science. Dept. of Applied Mathematics, Rehovot (Israel)
2936

AF 61(052)354
Free U. of Brussels (Belgium)
690

AF 61(052)356
Free U. of Brussels (Belgium)
691

AF 61(052)363
Uppsala U. Inst. of Physiology (Sweden)
2823

AF 61(052)375
Royal Inst. of Tech., Stockholm (Sweden)
2423, 2424

AF 61(052)377
Technische Hochschule. Mathematical Inst., Munich (Germany)
2736-2738

AF 61(052)391
Weizmann Inst. of Science. Dept. of Biophysics, Rehovot (Israel)
2937

AF 61(052)404
Maudsley Hospital, London (Gt. Brit.)
1572

AF 61(052)407
Royal Coll. of Science and Tech. Dept. of Mathematics, Glasgow (Scotland)
2422

AF 61(052)414
Trieste U. Mathematical Inst. (Italy)
2785

AF 61(052)423
Pavia U. Ist. di Fisica (Italy)
2010

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Technion - Israel Inst. of Tech. Dept. of Physics, Haifa
2717-2728

AF 61(052)454
Maudsley Hospital, London (Gt. Brit.)
1573

AF 61(052)461
Genoa U. Neurosurgical Clinic (Italy)
722, 723

AF 61(514)634-C
Istituto Nazionale di Ottica, Florence (Italy)
993

AF 61(514)945
Max-Planck Inst. für Psychiatrie, Munich (Germany)
1575

AF 61(514)953
Maudsley Hospital, London (Gt. Brit.)
1570, 1571

AF 61(514)957
Free U. of Brussels (Belgium)
689

AF 61(514)993
Training Center for Experimental Aerodynamics, Brussels (Belgium)
2780-2782

AF 61(514)1006
Heidelberg U. Pharmacology Inst. (Germany)
820

AF 61(514)1026
Milan U. Inst. of General Pathology (Italy)
1656, 1657

AF 61(514)1061
Paris U. Lab. de Physique (France)
2003

AF 61(514)1063
Technische Hochschule. Inst. für Angewandte Matematik, Karlsruhe (Germany)
2730

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Technische Hochschule. Mathematical Inst., Munich (Germany)
2732-2735

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Oxford U. Inorganic Chemistry Lab. (Gt. Brit.)
1998-2000

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Oslo U. Neurophysiological Lab. (Norway)
1960-1971

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Max-Planck Inst. für Strömungsforschung, Göttingen (Germany)
1574

AF 61(514)1163
Cork U. (Ireland)
538-541

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Dublin Inst. for Advanced Studies (Ireland)
611

AF 61(504)1170
Royal Coll. of Science and Tech. Dept. of Mathematics, Glasgow (Scotland)
2420, 2421

AF 61(514)1177
London U. Imperial Coll. of Science and Tech. (Gt. Brit.)
1109

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Burden Neurological Inst. Physiological Dept., Bristol (Gt. Brit.)
189-192

AF 61(514)1180
Oxford U. Dept. of Biochemistry (Gt. Brit.)
1972

AF 61(514)1182
Birmingham U. Dept. of Industrial Metallurgy (Gt. Brit.)
130

Contract Index

AF 61(514)1183
Oxford U. Engineering Lab. (Gt. Brit.)
1990-1997

AF 61(514)1184
Birmingham U. Dept. of Experimental Psychiatry (Gt. Brit.)
129

AF 61(514)1194
Copenhagen U. Inst. of Neurophysiology (Denmark)
537

AF 61(514)1207
Technische Hochschule. Inst. für Angewandte Matematik, Karlsruhe (Germany)
2729

AF 61(514)1213
Tiltman-Langley, Ltd., Surrey (Gt. Brit.)
2767, 2768

AF 61(514)1245
Louvain U. Lab. for Inorganic and Analytical Chemistry (Belgium)
1115, 1116

AF 61(514)1247
Uppsala U. Gustaf Werner Inst. for Nuclear Chemistry (Sweden)
2791-2792

AF 61(514)1248
Athens U. Dept. of Physics (Greece)
67

AF 61(514)1262
Fribourg U. Dept. of Physics (Switzerland)
702, 703

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Instituto de Quimica Fisica, Madrid (Spain)
957, 958

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959

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Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy)
979-986

AF 61(514)1333
Istituto Elettrotecnico Nazionale "Galileo Ferraris", Turin (Italy)
987, 988

AF AFOSR-60-1
Georgetown U. Dept. of Physics, Washington, D. C.
725, 726

AF AFOSR-60-4
Long Island Biological Assoc., Inc., N. Y.
1114

AF AFOSR-60-11
Rochester U. Dept. of Physics and Astronomy, N. Y.
2412

AF AFOSR-60-14
Instituto de Neurologia Montevideo (Uruguay)
953-956

AF AFOSR-60-22
National Research Council, Washington, D. C.
1764

AF AFOSR-61-4
Minnesota U. Dept. of Mathematics, Minneapolis
1691

AF AFOSR-61-7
Kansas U. Dept. of Chemistry, Lawrence
1065

AF AFOSR-61-10
St. Johns U. Dept. of Physics, Jamaica, N. Y.
2452

AT (30-1)2098
Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge
1357-1408

CSO-680-56-31
National Bureau of Standards, Washington, D. C.
1746

CSO-680-56-37
National Bureau of Standards, Washington, D. C.
1747

CSO-680-58-10
Bureau of Mines, Pittsburgh, Pa.
197

CSO-680-59-3
National Bureau of Standards, Washington, D. C.
1748-1750

CSO-680-59-6
National Bureau of Standards, Washington, D. C.
1751-1753

CSO-660-59-7
National Bureau of Standards, Washington, D. C.
1754, 1755

CSO-660-59-9
Bureau of Mines, Bartlesville, Okla.
193-196

CSO-680-60-2
National Bureau of Standards, Washington, D. C.
1756, 1757

DA 36-039-sc-56695
Illinois U. Coordinated Science Lab., Urbana
856, 857

DA 36-039-sc-64637
Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge
1425, 1426

DA 36-039-sc-73279
Columbia U. Columbia Radiation Lab., New York
462-487

DA 36-039-sc-78106
Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge
1427-1566

DA 36-039-sc-65122
Illinois U. Coordinated Science Lab., Urbana
658-662

AF EOAR-61-36
Pisa U. (Italy)
2102

ISSA-60-1
Veterans Administration Hospital, Boston, Mass.
2637

ISSA-660-59-12
Stanford Research Inst., Menlo Park, Calif.
2500

N6onr-25116
Stanford U. High-Energy Physics Lab., Calif.
2569-2594

N6onr-25123
Stanford U. Microwave Lab., Calif.
2599-2605

N7onr-29503
California U. Inst. of Engineering Research, Berkeley
320

Nonr-184110
Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge
1342-1356

Nonr-186616
Harvard U. Cruft Lab., Cambridge, Mass
741-746

Nonr-186632
Harvard U. Cruft Lab., Cambridge, Mass.
749-753

Nonr-22245
California U. Inst. of Engineering Research, Berkeley
312-319

Nonr-22524
Stanford U. Stanford Electronics Labs., Calif.
2632-2649

Nonr-22548
Stanford U. Microwave Lab., Calif.
2606-2609

Nonr-22552
Stanford U. Applied Mathematics and Statistics Lab., Calif.
2509-2512

Nonr-234200
Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.
667, 686

Nonr-245700
Brown U. Providence, R. I.
154

Nonr-49413
Tufts U. Inst. for Applied Experimental Psychology, Medford, Mass.
2766

OSR Control No. Index

OSR Control No. Index

The following is a list of all AFOSR reports to which control numbers were assigned and which were actually issued during this period. All omissions are deliberate; the absence of a number implies that the report assigned that number was never published.

AFOSR-TN-58-288	1639	AFOSR-TN-60-53	2470
		54	739
AFOSR-TN-59-539	11	55	1871
817	796		
AFOSR-TN-60-1	574	56	2362
2	1920	57	2363
3	1921	58	1211
4	685	59	2351
5	883	60	1835
6	559	61	1674
7	217	62	2248
8	605	63	841
9	468	64	1692
10	1811	65	1057
11	1629	66	1704
12	1189	67	281
13	2825	68	2901
14	2467	69	2902
17	1785	70	96
18	1786	71	2622
19	1748	72	1042
20	2857	73	74
22	2361	75	99
23	1330	76	100
24	1843	77	2152
25	2838	78	417
26	2839	79	418
27	2168	80	2016
28	2276	81	2826
29	933	82	2210
30	934	83	2211
31	2866	84	597
32	2867	85	2352
33	2505	86	2353
34	248	87	1844
35	596	88	142
36	1671	89	143
37	2169	90	625
38	1935	91	408
39	1412	92	409
40	1799	93	1672
41	1800	94	1043
43	1056	95	2920
45	428	97	606
46	1794	99	2413
47	2027	100	2079
48	1749	101	1621
49	1990	103	2478
50	2245	104	2191
51	614	105	1779
52	1022	106	2443

OSR Control No. Index

AFOSR-TN-60-107	2444	AFOSR-TN-60-173	1817
108	1896	174	1818
109	1609	175	2425
110	935	176	2426
111	1026	177	2427
112	936	178	2428
113	2023	179	2296
114	1594	180	2297
115	429, 2868	181	2298
116	252	182	232
117	253	183	2540
118	254	184	2541
121	1936	185	2407
122	2892	186	2408
123	2994	187	1725
124	301	188	312
125	2804	190	2212
126	2805	191	2776
127	2806	192	2807
128	532	193	979
129	533	194	1232
130	534	195	2194
132	1066	195A	2195
133	1067	197	1887
134	1917	198	1888
135	903	199	2542
136	898	200	1859
137	965	201	1233
138	2623	202	1234
139	2624	203	869
140	937	204	2140
141	2596	205	399
142	923	206	1897
146	2057	207	2338
147	2058	208	328
148	2059	209	68
149	2060	210	2213
150	2344	211	2311
151	2625	212	29
152	376	213	2438
153	2875	214	218
154	2876	215	219
155	865	216	220
156	848	217	2291
157	2466	218	2893
158	650	219	3037
159	651	220	3038
160	1680	221	3039
161	69	222	3040
162	236	223	766
164	1826	224	200
165	2711	225	2214
167	2539	226	2215
168	803	227	2364
169	2698	228	2163
170	2699	229	2164
171	1033	230	2365
172	33	231	2366

AFOSR-TN-60-232	2367	AFOSR-TN-60-292	1246
233	2170	294	2004
234	2196	295	1827
235	1	297	1812
237	2780	298	822
238	1941	299	1652
239	871	300	243
240	2028	301	2253
241	2029	303	1190
242	2030	304	1191
243	2031		
244	2032	305	1082
245	2249	306	1192
246, Pt. 1	1893	307	2938
246, Pt. 2	1894	308	804
247	3035	309	980
248	1245	310	67
249	1174	311	2930
250	2923	312	2931
251	2924	313	2932
252	2788	314	994
253	2789	315	2626
254	2790	317	1576
255	2733	318	171
256	2734	319	2400
257	35	320	2518
258	2033	321	2519
259	1595	322	1807
260	2527	323	255
261	2968	324	2165
262	2915	325	1583
263	1630	326	1633
264	1631	327	2830
265	1632	328	396
267	2216	329	1247
268	313	330	560
269	2497	331	5
270	2368	332	2403
272	2925	333	2404
273	787	334	1262
274	788	335	2207
275	2409	336	2501
276	377	337	2674
277	378	338	2794
278	379	339	2439
279	1991	340	555
280	1992	341	1064
281	2705	342	909
282	242	343	2729
283	2239	344	1235
284	2416	345	1236
285	2739	346	1237
286	57	347	1574
286a	58	348	2420
287	213	349	1058
288	1222	350	444
289	567	351	2185
290	1276	352	2203
291	80	353	2204

OSR Control No. Index

AFOSR-TN-60-354	1193	AFOSR-TN-60-418	524
355	740	419	889
356	1305	420	1142
357	1306	421	454
358	2869	422	1117
359	938	423	805
360	2255	424	1956
361	2256	425	524A
362	2257	426	20
363	2993	427	2468
364	2092	428	1677
365	029	429	2532
366	2969	430	2142
367	81	431	169
368	910	432	170
371	2926	433	1787
372	1212	434	511
373	1686	435	1238
374	369	436	940
375	172	437	671
376	1083	438	2369
377	950	439	1263
378	97	440	355
379	832	441	1605
380	2520	442	1606
381	2521	443	842
383	2522	444	2394
384	2523	445	437
385	1607	446	1214
386	1213	447	488
387	2250	448	2324
388	874	449	2545
389	875	450	1973
392	1097	451	507
393	2307	452	314
394	2543	453	2877
395	769	454	2878
396	2870	455	1194
397	1021	456	1919
398	2479	457	2292
398A	2154	459	2907
399	2480	460	1649
400	2702	461	1589
402	2675	462	1044
403	939	463	1045
404	1584	464	1249
405	2354	465	134
406	2171	466	1239
408	404	467	135
409	577	468	344
410	52	469	345
411	412	470	1023
412	2391	471	1024
413	53	472	233
414	675	473	256
415	2524	474	2370
416	1248	475	1940
417	2544	476	2566

OSR Control No. Index

AFOSR-TN-60-477	2348	AFOSR-TN-60-539	157
478	789	540	2791
479	144	541	759
481	145	542	760
482	146	543	2013
483	1116	544	941
484	2951	545	942
485	2916	546	2546
486	626	547	2879
487	232	548	1048
488	2506	549	499
489	405	550	1251
490	419	551	2121
491	1765	552	790
492	1788	554	321
493	1789	555	530
494	2952	556	400
495	981	557	54
496	2312	558	1710
497	1839	559	1711
498	2103	560	1790
499	2772	561	1769
500	2773	562	2688
501	1195	563	2689
502	1781	564	2690
503	1250	565	2691
504	2146	566	2692
505	1277	567	2880
506	439	568	943
507	398	569	2076
508	2155	570	1175
509	292	571	1176
510	282	572	1177
511	2989	573	2975
512	2494	574	1618
514	2481	575	438
515	1138	576	1264
516	1322	577	2568
517	1323	580	629
518	491	581	630
519	2437	582	1027
522	1215	583	672
523	1795	584	673
524	1901	585	2534
525	876	586	137
526	1900	587	1307
527	329	588	564
528	2147	589	500
529	2172	590	2858
530	1046	592	310
531	1047	594	761
532	3046	595	2034
533	2533	596	2035
534	2173	597	2036
535	627	598	2037
536	628	599	2038
537	3041	600	1791
538	156	601	293

OSR Control No. Index

AFOSR-TN-60-602	2174	AFOSR-TN-60-662	72
603	2287	664	427
604	2475	666	203
606	1579	667	204
607	133	668	205
608	1298	669	206
609	356	670	2156
610	357	671	1084
611	36	672	430
612	492	673	1684
613	911	674	2
614	912	675	1153
615	3025	676	1154
616	359	677	1098
617	359	678	2419
618	360	679	380
620	406	680	2787
621	331	681	2001
622	425	682	1796
623	426	683	2795
624	2093	684	2796
625	600	685	2797
626	1610	686	2798
627	465	687	1957
628	1930	688	523
629	92	689	2005
630	568	690	6
631	554	691	2094
632	851	692	1752
633	1598	693	678
634	386	694	679
635	887	695	680
636	221	696	681
637	714	697	682
638	583	698	884
639	2148	699	1782
640	2863	700	1104
641	2927	701	71
642	2872	702	21
643	584	703	315
644	55	704	1265
645	2547	705	2414
646	2299	706	179
647	175	707	322
648	2482	708	1714
649	2483	709	466
650	2217	710	2840
652	2333	711	2713
653	724	712	391
654	347	713	1743
655	2859	714	2548
656	1028	715	1906
657	710	716	2513
658	2853	717	1813
659	493	718	2277
660	494	719	2844
661	729	720	2395
662	348	721	762

OSR Control No. Index

AFOSR-TN-60-722	1252	AFOSR-TN-60-788	3016
723	1253	789	2157
724	480	790	2854
725	2917	791	1918
726	2293	792	852
728	381	793	420
729	382	794	1902
730	951	795	890
731	2982	796	622
732	2983	797	2799
733	986	799	2894
734	410	801	806
735	411	802	2939
736	2535	803	324
738	892	804	1198
739	189	805	2507
740	2244	806	244
741	190	807	867
742	620	808	59
743	821	809	2895
744	2278	810	1730
745	1590	812	336
746	2685	813	3042
747	1223	815	715
748	1792	816	337
749	81	817	2904
750	1717	818	1199
751	1718	819	1200
752	1719	821	2473
753	1720	823	2550
754	2693	824	2888
755	589	828	1580
756	570	827	2703
757	431	828	3022
758	2273	829	2258
759	2440	830	1413
760	12	831	1299
761	1196	832	1801
782	1197	833	2525
783	2401	834	1414
764	477	835	2769
765	2455	838	2149
768	1840	837	2551
787	2371	838	1035
768	2372	839	1036
769	2549	840	704
770	2081	841	1100
771	2082	842	1101
772	2083	843	56
773	335	844	239
774	2909	845	2095
775	1942	848	1415
776	3010	848	2096
778	3011	849	2514
779	3012	850	2175
782	3013	851	2831
783	3014	852	2681
786	3015	853	1201

OSR Control No. Index

AFOSR-TN-60-854	1087	AFOSR-TN-60-914, Pt. 3	2138
855	1088	915	2139
856	338	916	701
857	2294	917	2006
858	495	918	770
859	1653	919	502
860	2714	920	503
861	2627	921	2233
862	2528	922	1876
863	501	923	877
864	1240	924	967
865	730	925	968
867	2921	926	1946
868	1085	927	2476
869	212	929	1705
870	1178	930	2808
872	1875	931	2628
875	607	932	302
876	608	933	2373
877	2953	935	82
878	294	936	538
879	3036	937	2811
880	964	938	543
881	1937	939	1958
882	2396	940	1959
883	880	941	2007
884	50	942	2841
885	2781	945	731
886	2662	946	556
887	7	947	13
888	8	948	1203
889	2084	949	2271
890	1099	950	2770
891	257	951	1821
892	258	953	2166
893	259	954	2754
894	2218	955	83
895	2744	956	2319
896	222	957	2330
897	223	959	928
898	1202	960, Pt. 1	361
899	1943	960, Pt. 2	362
900	1944	960, Pt. 3	363
901	1945	961	1102
902	2845	962	2842
903	1254	963	2484
904	2536	964	2882
905	136	965	1814
906	1578	966	712
907	1577	967	1624
908	240	969	2039
909	478	970	2040
910	868	971	2041
911	763	972	2042
912	764	973	2043
913	392	974	2044
914, Pt. 1	2136	975	2045
914, Pt. 2	2137	976	2046

OSR Control No. Index

AFOSR-TN-60-977	525	AFOSR-TN-60-1036	1891
978	2080	1039	2376
979	323	1041	818
981	1143	1042	1993
982	615	1043	1994
983	616	1044	2995
984	1850	1045	2996
985	1861	1046	617
986	2143	1047	618
987	1872	1048	1122
988	1882	1050	1123
989	2827	1051a	1204
990	2828	1051b	1205
991	1612	1052	1933
992	1619	1053	1934
993	2767	1054	1634
994	807	1055	332
995	808	1056	2837
996	2707	1057	2862
997	2313	1059	1255
998	445	1060	1029
999	446	1061	241
1000	224	1062	1617
1001	225	1063	707
1002	2485	1064	2377
1003	2843	1065	598
1004	2768	1066	531
1005	973	1067	1687
1006	974	1068	1278
1007	975	1069	1279
1008	976	1070	2011
1009	995	1071	1620
1010	996	1072	537
1011	997	1074	1071
1012	998	1075	1072
1013	999	1077	1650
1014	1000	1078	1651
1015	528	1079	2800
1016	1998	1080	2801
1017	1999	1081	383
1018	234	1082	384
1019	1862	1083	385
1020	2985	1084	386
1021	2986	1085	2657
1022	2374	1086	2775
1023	2325	1087	2486
1024	913	1089	1206
1025	2014	1090	914
1026	245	1091	479
1027	104	1092	397
1028	1089	1094	1416
1029	727	1095	2668
1030	41	1096	2669
1031	2905	1097	2508
1032	1842	1099	1883
1033	927	1100	585
1034	929	1101	2976
1035	2375	1102	2977

OSR Control No. Index

AFOSR-TN-60-1103	1808	AFOSR-TN-60-1164	1829
1105	2984	1165	2150
1106	1960	1166	2018
1107	1961	1167	2019
1108	1962	1170	2300
1109	1963	1171	295
1110	1964	1172	2694
1111	1965	1173	1602
1112	1966	1175	1422
1113	1967	1176	2474
1114	1968	1177	2176
1115	1969	1178	623
1116	878	1179	797
1117	891	1180	798
1118	1280	1181	799
1119	838	1182	800
1120	2802	1183	716
1121	1898	1184	481
1122	2683	1185	2502
1123	2378	1186	2122
1124	1216	1188	873
1125	977	1189	42
1126	2975	1190	131
1127	2097	1191	132
1128	794	1192	693
1129	1256	1193	694
1130	944	1194	2846
1131	930	1195	1336
1132	899	1196	1622
1133	2552	1197	2158
1134	2553	1198	2355
1135	2554	1199	1845
1136	2555	1200	771
1137	2556	1201	249
1138	765	1202	3023
1139	2755	1203	1635
1141	2737	1205	1636
1142	2940	1206	969
1143	989	1207	830
1144	2104	1208	831
1145	283	1209	1654
1146	1878	1210	1115
1147	1879	1211	455
1148	1421	1212	456
1149	101	1213	2379
1150	2197	1214	2220
1151	2198	1215	1922
1153	738	1216	1923
1154	1281	1217	1924
1155	655	1218	1925
1156	656	1219	1926
1157	657	1220	497
1158	658	1221	193
1159	447	1222	1696
1160	514	1223	2928
1161	2219	1224	2929
1162	2326	1225	85
1163	2530	1226	86

AFOSR-TN-60-1227	34	AFOSR-TN-60-1291	823
1229	2167	1292	824
1230	2896	1293	825
1231	339	1294	1658
1232	952	1295	1659
1234	1715	1296	1171
1235	844	1297	1970
1236	1637	1298	1974
1237	30	1299	1001
1238	2998	1300	1002
1240	2610	1301	1678
1241	2855	1302	2199
1242	1809	1303	304
1243	2670	1304	2151
1244	2671	1305	2557
1245	2672	1308	1877
1246	708	1309	1995
1247	180	1310	1155
1248	463	1311	1156
1249	631	1312	1157
1250	632	1313	1158
1251	633	1314	1159
1252	2847	1315	389
1253	303	1316	390
1254	1756	1317	1110
1255	2990	1318	2088
1256	352	1319	2089
1257	432	1320	2090
1259	2429	1321	2091
1260	1907	1325	1077
1261	2477	1326	1003
1262	496	1327	1004
1263	147	1328	1005
1266	1688	1329	1006
1267	586	1330	2526
1268	587	1331	2177
1269	349	1332	2301
1270	1785	1334	1282
1271	1172	1335	1283
1272	2105	1336	1284
1273	2106	1337	2595
1274	2107	1338	2295
1275	2108	1339	333
1276	2109	1340	2144
1277	2110	1341	2456
1278	2111	1342	2159
1279	2112	1343	3043
1280	2113	1344	2490
1281	2114	1345	1971
1282	2115	1346	1767
1283	2116	1347	1768
1284	2117	1348	826
1285	2118	1349	535
1286	645	1350	536
1287	1935	1351	900
1288	1936	1352	853
1289	1987	1353	854
1290	1988	1354	855

OSR Control No. Index

AFOSR-TN-60-1355	188	AFOSR-TN-60-1418	1873
1356	624	1419	1691
1357a	515	1420	1585
1357b	516	1421	1119
1358	517	1422	1120
1359a	518	1423	978
1359b	519	1424	1586
1360	520	1425	1587
1361	521	1426	926
1362	2495	1427	953
1363	1160	1429	522
1364	2327	1430	2531
1365	2290	1431	2308
1366	2558	1432	448
1367	1581	1434	1207
1368	2314	1435	2559
1370	1694	1436	2560
1371	1849	1437	2160
1372	1600	1438	1037
1373	1182	1439	2356
1374	1030	1440	2823
1375	2756	1441	1975
1376	2757	1442	1162
1377	843	1443	1163
1378	720	1444	1444
1379	2664	1446	2758
1380	2665	1447	901
1381	2399	1448	2697
1383	3	1449	619
1384	1161	1450	2279
1385	1074	1451	185
1387	353	1452	186
1388	2883	1453	1802
1389	2405 and 2884	1454	31
1390	2885	1455	2283
1391	2897	1456	1731
1392	2415	1457	2537
1393	1823	1458	1034
1394	881	1459	3047
1395	2765	1460	1611
1396	194	1461	1582
1397	1224	1462	737
1402	2345	1464	1681
1403	690	1465	1682
1404	1016	1466	595
1405	700	1467	474
1406	2793	1468	1655
1407	801	1469	1132
1408	2611	1470	1133
1409	2612	1471	1134
1410	2613	1472	1135
1411	1031	1473	37
1412	711	1474	284
1413	592	1475	2186
1414	195	1476	105
1415	2614	1477	196
1416	413	1478	25
1417	1695	1479	2120

OSR Control No. Index

AFOSR-TN-60-1480	1049	AFOSR-TR-60-46	757
1461	2650	48	2762
1462	2651	49	84
1463	1417	50	1916
1484	1416	51	2751
1485	791	52	736
1486	792	53	173
1487	2634	54	1109
1466	603	55	2418
1489	2716	56	62
1490	1173	57	2706
1491	2615	58	547
1492	1764	59	550
1493	1076	60	40
1494	2098	61	2421
1495	833	62	1337
1496	834	63	1020
		64	27
		65	1604
		66	962
AFOSR-TR-60-1	3026	67	987
2	2465	69	1702
3	2903	70	158
4	2910	71	1093
6	416	72	2979
8	2446	73	957
10	506	74	924
11	1750	75	1830
12	612	77	1423
13	2715	76, Pt. 1	176
14	578	78, Pt. 2	177
15	107	79	2763
17	2445	61	663
16	2739	62	696
19	2700	83	870
21	2676	87	1881
22	16	86	1665
23	459	90	1675
24	1568	91	1728
25	702	92	2786
26	326	93	1819
27	1761	94	70
26	63	95	1331
29	2500	96	2251
30	2002	96	103
31	1712	99	45
32	154	100	2240
34	423	101	609
35	2129	102	2906
36	1569	103	1086
37	2309	106	2071
38	2397	107	601
40	2735	109	970
41	2933	110	1036
42	1656	111	1326
43	2699	112	1831
44	26	114	2471
45	571	115	1942

OSR Control No. Index

AFOSR-TR-60-116	1608	AFOSR-1	2161
117	2339	2	2145
118	1613	3	2491
119	2997	4	2886
120	2315	5	1257
122	198	6	1258
123, Pt. 1	1736	7	1697
123, Pt. 2	1737	11	150
124	1090	12	151
125	2918	13	152
126	476	14	1892
127	526	17	2205
127a	527	18	9
128	839	19	2357
129	767	20	593
130	872	21	718
131	1640	22	2487
133	1753	25	1225
134	2730	26	772
135	2710	28	407
136	2328	30	285
137	849	31	2616
138	102	32	558
139	544	35	2272
140	2732	39	3008
141	879	40	1951
142	545	41	960
143	2745	45	1913
144	897	46	1592
146	2274	47	1241
147	2515	48	2321
149	603	49	2322
150	604	51	2200
158	87	52	2848
159	2015	53	296
160	182	56	305
161	2750	60	2017
162	207	61	201
163	599	65	2860
164	181	71	2099
165	1797	72	1910
167	94	73	2863
168	2529	74	2492
170	130	82	199
171	62	83	1863
172	2453	84	1864
173	509	85	1865
174	394	86	1866
176	2334	90	1713
177	1911	95	2887
178	644	97	2561
180	183	98	2008
181	529	99	2941
182	106	110	1136
183	2496	111	990
184	721	114	2836

OSR Control No. Index

AFOSR-117	2503	AFOSR-260	2284
119	1726	261	2285
121	1091	270	287
122	49	271	1899
123	2123	274	330
125	1242	284	1663
134	2010	287	108
135	2085	288	1075
138	2131	289	1076
139	1266	290	1952
140	1314	291	370
141	1315	299	2864
144	705	303	1758
153	316	311	2304
155	1625	316	1332
156	2663	319	2358
161	364	323	1977
162	365	324	1978
165	214	325	1979
167	2785	326	1980
168	959	327	1981
169	2942	328	1081
170	2943	329	1170
171	2944	330	2423
172	4	331	2424
174	1208	333	2201
183	2047	334	2747
184	2048	337	2417
186	2049	344	2775
188	2050	350	722
191	1914	351	2119
192	1910	359	1166
196	2430	360	75
197	2431	363	1113
201	286	364	1268
205	275	365	2132
206	276	367	723
207	277	373	2346
210	2777	377	1111
211	1261	382	2141
216	2178	385	2009
217	1183	386	648
224	699	395	713
225	819	406	2888
226	1828	410	1269
229	1341	413	2658
233	1017	415	2738
234	1018	417	2433
236	1165	419	38
237	1165A	421	1783
238	1068	430	1721
244	260	432	1690
245	261	449	539
250	1976	450	540
255	1267	451	541
257	2448	455	2861
258	2449	465	2457
259	2450	466	2458

OSR Control No. Index

AFOSR-467	2459	AFOSR-776	1139
474	2221	796	1420
498	1167	800	802
499	1982	803	1126
500	1112	804	1127
501	2873	805	1128
508	2776	806	1129
512	1572	807	1130
514	2812	814	95
521	2673	827	3024
522	2813	831	773
523	2814	835	2380
525	2815	839	728
526	2816	850	2817
527	202	861	1339
535	2434	862	1340
536	2435	876	262
537	2436	881	1009
541	548	882	1010
551	1316	883	1972
563	350	884	1983
568	1996	916	2422
584	2889	957	1932
607	1121	962	1003
608	1124	982	991
610	1125	999	1388
611	1270	1002	1059
612	1320	1003	1060
618	634	1004	1061
620	489	1016	2849
624	642	1018	3009
625	732	1038	1131
633	278	1046	1679
648	208	1062	754
650	2208	1063	755
661	2562	1064	756
676	17	1089	1732
677	18	1106	128
688	2242	1107	850
694	1338	1121	2381
705	2832	1142	1706
713	2779	1143	1707
715	1073	1144	1708
718	2179	1167	954
719	2829	1168	955
721	1763	1188	1759
722	1780	1189	1760
727	1931	1242	1660
728	1815	1243	1661
735	2937	1252	2463
736	1989	1281	2382
737	2658	1285	1011
738	2659	1286	1012
739	2660	1287	1013
740	2661	1288	1014
741	1007	1289	1015
742	1008	1290	441
774	1591	1291	1435

OSR Control No. Index

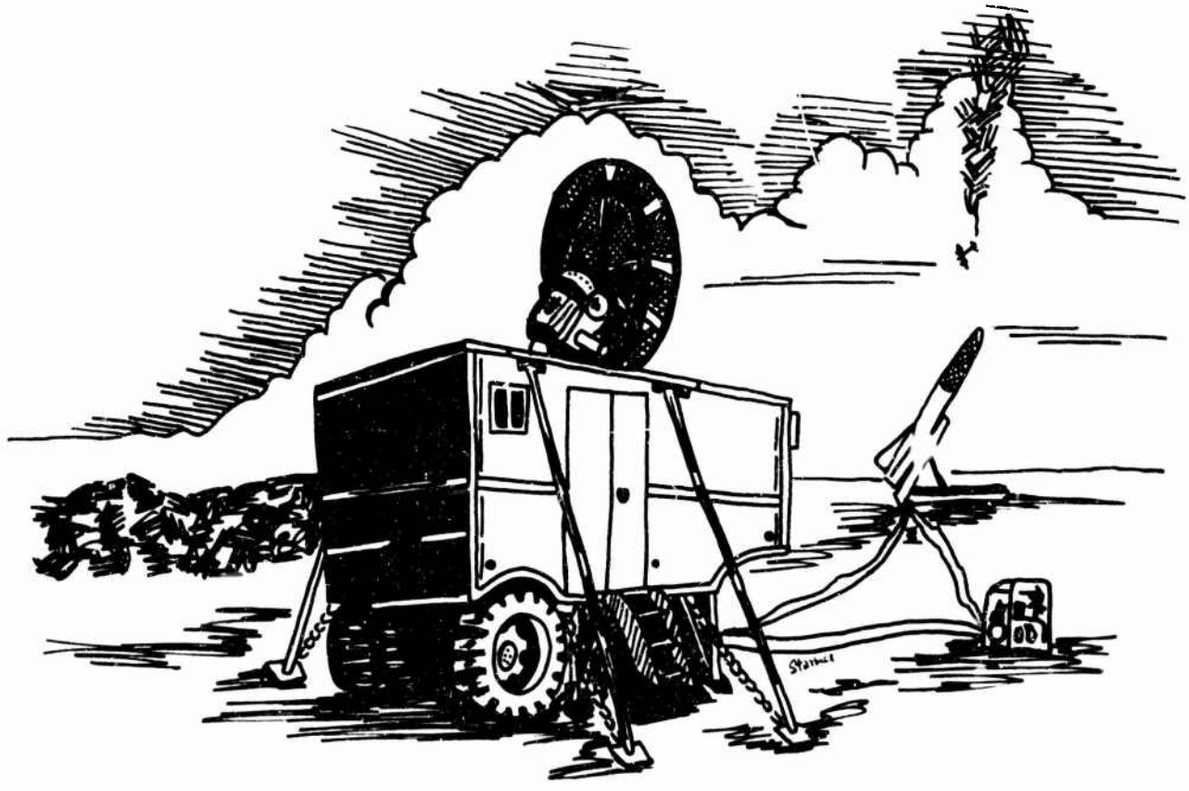
AFOSR-1292	1079	AFOSR-2466	1810
1295	1744	2468	2162
1328	1168	2469	2222
1329	1265	2471	299
1338	60	2472	300
1340	2809	2493	827
1355	646	2494	306
1364	1065	2495	961
1389	793	2496	197
1444	2451	2497	2748
1445	2652	2498	962
1446	1700	2511	691
1460	2288	2741	956
1476	2392	2793	2383
1506	215	2797	1149
1509	2731	2798	1729
1528	148	2824	2991
1535	1733	2863	3021
1536	1734	2964	230
1545	2460	2988, Pt. 1	1105
1585	401	2988, Pt. 2	1106
1641	1776	3038	2020
1644	821	3061	2124
1646	2412	3062	2125
1655	2653	3079	1836
1656	2654	3080	1837
1657	2655	3081	1838
1660	1324	3092	809
1689	561	3093	810
1690	562	3094	811
1719	442	3095	812
1720	443	3096	813
1798	231	3097	814
1846	1096	3107	725
1871	1885	3127	726
1878	1722	3136	2987
1879	1723	3158	2509
1899	1724	3174	2988
1944	43	3244	1689
1954	2342	3255	2280
2125	159	3256	2281
2135	250	3257	2282
2170	2102	3265	904
2184	1019	3266	3029
2288	334	3268	1243
2329	2051	3273	1095
2330	2052	3282	1638
2331	2053	3287	351
2340	297	3289	414
2367	1025	3290	415
2379	2225	3294	1308
2381	2226	3295	1309
2382	2227	3300	1293
2423	1841	3301	1294
2462	1927	3302	1295
2463	1803	3323	654
2464	1804	3328	433
2465	1805	3329	434

OSR Control No. Index

AFOSR-3330	435	AFOSR-3796	2335
3337	467	3798	931
3338	247	3799	932
3358	1673	3802	47
3377	2432	3803	1107
3378	1846	3814	2695
3379	774	3818	371
3380	2667	3919	372
3386	2234	3820	373
3408	588	3821	374
3410	279	3822	375
3413	402	3829	2072
3414	216	3838	2074
3418	589	3839	2075
3435	1793	3840	2076
3437	2567	3842	1698
3458	1169	3849	917
3491	1847	3851	918
3511	2712	3857	919
3520	2024	3859	920
3549	64	3866	2329
3550	65	3892	1108
3552	885	3919	288
3554	1601	3923	1908
3579	2252	3924	1909
3582	1599	3927	2469
3585	1716	3975	1313
3590	93	3981	340
3592	1905	3982	341
3594	915	3983	342
3597	916	3992	1904
3598	2778	3995	892
3601	2677	3997	893
3602	2676	4027	1895
3603	2679	4049	251
3604	2680	4065	988
3605	2681	4116	2406
3606	2682	4158	2223
3620	1664	4209	2187
3621	1665	4252	888
3622	1666	4262	1144
3623	1667	4266	1145
3628	354	4267	1146
3634	2504	4273	1147
3640	1953	4287	882
3641	1954	4309	563
3644	1955	4356	1806
3651	2393	4433	684
3658	424	4438	1597
3665	1676	4440	2684
3667	1318	4467	686
3676	2856	4978	1775
3719	1738	5017	2442
3720	1739	5195	1424
3721	1740	5200	2077
3722	1741	5213	1668
3760	191	5490	1884
3792	46		

OSR Control No. Index

AFOSR-J29	992	AFOSR-J354	2347
38	2803	511	1625A
60	226	519	2959
65	298	787	2259
70	3017	793	2260
71	3018	806	2261
76	905	815	2262
79	906	816	2263
88	733	819	2264
90	421	1002	1286
94	209	1379	652
109	2954	1485	2384
112	2955		
114	2956		
115	2957		
118	2958	AFOSR-64-0168	1287
133	2402	0827	1567
291	2617	1047	3019
292	2618	2485	1310
293	2619	2493	3020



Author Index

Abarbanel, S. S.
1338-1340
Abbott, D. E.
2530
Abramson, N. M.
2633, 2638
Acha, A., de
1148
Adam, F. C.
2900
Adams, H. S.
667, 670
Adams, J. A.
898-901
Adams, O. W.
841
Adey, W. R.
334
Adler, R. L.
3007
Adolfsson, G.
2807
Adsit, N. R.
1896
Agawa, T.
848
Agmon, S.
797
Agoston, G. A.
2501
Ahlfors, L. V.
758, 762
Aki, K.
230
Albe-Fessard, D.
1152-1156, 1160-1162, 1170
Albers, W. A., Jr.
2932, 2933
Albert, A.
2512
Albert, A. A.
3000
Alberts, W. W.
1731-1735
Albini, F. A.
211, 215
Alexander, K.
820
Alexopoulos, K. D.
67
Almenningen, A.
1907-1909
Allen, R. G.
2016, 2017
Aller, L. H.
217
Allis, W. P.
1447
Allison, F.
603
Allred, W. P.
88
Alsop, L. E.
510
Altman, I.
829-831
Alvarez, R. A.
2583
Ambrose, W.
1293, 1294
Ames, A., III
1287, 1291
Amitsur, S. A.
3006
Ammar, R. G.
455-458
Amme, R. C.
965, 969
Amorós, J. L.
1144-1148
Andersen, E. S.
2
Andersen, P.
1960, 1964, 1967-1969
Anderson, F.
1044
Anderson, L. W.
1948
Anderson, M. E.
2528, 2535, 2536
Anderson, R. C.
2748
Anderson, R. S.
1182-1184, 1186-1188
Anderson, S.
1882, 1883
Andrade, E. N. da C.
1109
André, J.
2367
Angell, D.
59
Angelman, C. C.
1373
Angoletta, M.
1649
Ankeny, N. C.
1300
Annaka, S.
1144, 1146
Apelbaum, J
950, 2463
Aponte, J. D.
1824
Araki, H.
2266
Araki, S.
238
Aranow, R. H.
2391
Arbib, M.
1565
Arden, G. B.
1079
Arduini, A.
2106, 2109, 2116, 2117, 2119
Argabright, P.
475
Argan, P. E.
721
Arizmendi, L.
957, 958
Arkell, A.
1913
Arking, A.
595

Author Index

Armenakas, A. E.
524A
Armstrong, J.
746
Arnowitt, R.
144-147, 2261
Aronowitz, L.
2351, 2358
Aronson, J. R.
1025
Aronsson, B.
2795-2798
Arthur, P.
1939
Asakura, T.
1020
Ascarelli, G.
894, 1471, 1541
Ascher, Ph.
1157
Åselius, J.
2799
Asher, G. W.
1335
Ashley, H.
1335
Askew, R. F.
2854
Askey, R.
2870
Asplund, E.
933, 937, 940
Atherton, J. M.
2896
Aubrey, B. B.
1426, 1482
Auzins, P.
1714-1716
Avakian, P.
1352
Avivi, P.
818
Ayres, R.
1215
Azaroff, L. V.
846, 851-855

Bacher, F.
1171
Bachmann, L.
567, 568
Bäckström, G.
2812, 2820, 2821
Bade, W. G.
3001, 3003
Badessa, R. S.
1455
Baewster, W. R.
1037
Bagemihl, F.
1618
Baghdady, E. J.
1431, 1465, 1503
Bagley, F. D.
2858, 2860, 2861
Bahiana, L.
1500
Bair, E. J.
926
Baird, J. R.
906
Bak, B.
532-536
Baker, A. G.
1555, 1564
Baker, J.
1646
Baker, J. G.
626, 628, 638
Baker, M.
2541
Baker, R. M. L., Jr.
339, 343
Baldeschwieler, J. D.
234
Baldwin, D. E.
1549
Baldwin, R. R.
822-828
Balescu, R.
689, 693-698
Balluffi, R. W.
871, 872, 881
Baney, R. H.
2991
Banks, E.
2140
Bannister, W.
2293
Barach, J. P.
1263
Barber, R. C.
1138, 1139
Barber, W. C.
2569, 2575-2577, 2585
Barcus, J. R.
1777
Bar-Eli, A.
2937
Barker, W. A.
2454
Barlow, J. S.
1280, 1281, 1286, 1289
Barndorff-Nielsen, O.
1
Barnes, R. L.
2013
Barnett, P. E.
1776
Baron, J. R.
1413, 1419
Barr, J. B.
2014
Bartlett, R. W.
2830, 2831
Barut, A. O.
2688-2696
Bashandy, E.
2814
Basolo, F.
1882-1884
Bass, R. W.
2388
Bassi, M.
1657

Bastiansen, O.
1907-1909
Bate, R. T.
85-91
Batson, A. P.
2854
Bauer, A.
2832
Bauer, R. A.
767
Bauer, R. W.
1391, 1393
Bauer, S. W.
2988
Bauer, W. H.
2340, 2341
Baum, L. H.
11-14
Baumann, E.
2839
Baumann, K.
2841, 2842
Bauminger, R.
819
Baxter, G.
1672, 1691
Bazley, N. W.
1747
Beane, B. J.
39
Beard, G. B.
1594-1596
Bearman, R. J.
1065
Bechhofer, R.
596
Beckel, C. L.
725, 726
Becker, J. A.
667
Becker, L.
2580
Becker, L. B.
30, 31
Becker, R. C.
905, 906
Beckett, J. C.
331
Beer, A. C.
85-87, 90, 91
Beers, D. S.
595
Beers, Y.
1821, 1822
Beisner, H. M.
1925, 1926
Bekefi, G.
1425, 1441, 1446, 1488, 1489, 1546, 1550
Bell, J. C.
86
Bell, J. F.
1035, 1036
Bell, T. F.
2625
Bellar, F. J., Jr.
1251
Bellmer, W. A.
2170
Benedek, G. B.
746
Benedict, W. S.
1063
Benkeser, R. A.
2290
Bennett, A. I.
2981
Bennett, L. H.
2444
Bergendahl, G.
1066
Berger, S. A.
2220
Bergmann, K.
2245, 2246
Bergner, P.-E. E.
1069
Bergström, I.
1827, 1828
Berne, R. M.
2976
Bernelli-Zazzera, A.
1657
Bernhard, C. G.
1072
Bernicker, R. P.
1418
Berrigan, P. J.
2291
Berry, R. S.
1612, 1613
Bers, L.
758
Berson, J. A.
2470-2472, 2475
Berthold, F.
2575, 2576, 2585
Bertler, A.
1122, 1123, 1126-1130
Bertram, J. E.
2385, 2386
Beshers, D. N.
525
Besseling, J. F.
2523, 2526
Betser, A. A.
2710
Bevans, J. T.
299
Bevensee, R. M.
1463
Bhapkar, V. P.
1867, 1870
Bhattacharya, B. N.
627
Bianchi, G.
1652-1655
Bidwell, L.
2078
Biedermann, G.
2431
Bierrum, N. R.
1992, 1995
Bigelow, S.
523
Billings, J. H.
1250

Author Index

Biorci, G.
979-986
Birchenall, C. E.
2248, 2249, 2251, 2253
Birdsall, C. K.
294
Birdsall, T. C.
1464
Birnbaum, M.
2174
Bishop, J. J.
2288
Bittini, M.
998-1000, 1003, 1008, 1014
Bixson, L. L.
2662, 2663
Bizzi, E.
2463, 2464
Bjorken, J. D.
2539, 2543, 2563
Bjorkstam, J. L.
2911, 2912
Black, P. J.
374
Blake, R. E.
2827
Blakemore, J. S.
1664-1666
Blankenbecler, R.
2256, 2267, 2270, 2304
Blaschko, H.
1985-1989
Blatt, F. J.
1597
Blatt, J.
2942
Blattner, M. M.
345
Blau, M.
1589-1591
Blin-Stoyle, R. J.
1369, 1385
Bloch, S C.
1588
Block, M. M.
1051, 1054, 1055
Bloembergen, N.
744, 747
Blois, M. S.
2513-2517
Bloom, G.
1076
Bloom, M. H.
2143, 2144
Blum, M.
1513
Blumer, C. R.
1829
Bochner, S.
2229, 2230, 2235, 2237, 2238
Bock, R. D.
1876, 1877
Boer, P. C. T., de
1266
Bogacz, J.
954, 955
Bogart, L.
2570
Boggus, J. D.
649
Bohm, H. V.
2935
Bonacalza, E.
1827
Bonazzola, S.
1658
Bonfiglioli, G.
987-992
Bonnell, J. M.
2307, 2308
Bonsack, W. K.
220, 222, 223
Bonstrom, D. B.
1676
Boone, E. M.
1910, 1917
Booth, D.
822, 826
Booth, R. E.
2973
Bordell, F. L.
668
Borel, A.
2234
Bordoni, U.
1661
Borenstein, P.
1150, 1165
Borg, R. J.
2250
Borgatta, E. F.
1794-1797
Bosco, B.
1207
Bose, R. C.
1854, 1857, 1863-1866
Bostick, W. H.
2652-2656
Boudart, M.
2192-2197, 2200-2202
Bow, N.
602
Bowen, J. I.
417, 418, 422
Bowers, R. V.
738
Bowman, W.
1408
Boyce, W. E.
2343-2346
Boyd, K. E.
2826
Boynton, J. H.
579
Brabers, M. J.
2252
Bracchi, F.
1659, 1660
Bracewell, R. N.
2610, 2611, 2614, 2618
Brachet, J.
691
Brackmann, R. T.
706, 708
Bradley, L. C., III
1426, 1482

Bradley, P. B.
129
Bradley, R. C.
571-573, 595
Brady, P. T.
1520
Braga, E. P.
2191
Bragg, R. H.
844-846, 851
Braitenberg, V.
1742, 1743, 1745
Bramble, J. H.
1230, 1253, 1254, 1256, 1258
Branden, C. I.
2808
Brandstatter, J. J.
2623
Branges, L., de
947, 949
Branson, L. K.
23, 29
Brauer, A.
1842
Brazier, M. A. B.
1280, 1282, 1283, 1285, 1288, 1292
Bredon, G.
937
Breit, G.
3024, 3025
Bremond, B.
2009
Brenig, W.
1396
Breslau, M.
2325
Brice, N. M.
2628
Bridge, H. S.
1387
Bridges, W. B.
294
Brient, S. J.
2754
Briggs, L. J.
57, 58
Brisbout, F. A.
2664, 2666
Brittain, J. O.
1896-1899, 1905
Brocard, J.
528, 529
Brocher, E. F.
589, 591
Brodbeck, M.
1771, 1773
Brody, R. A.
1906
Broglio, L.
2419
Brooks, C. T.
826
Broom, T.
130
Brotzen, F. R.
2396
Brovetto, P.
989, 990
Brown, A.
2395
Brown, F. C.
889, 891-893
Brown, H. W.
2513, 2517
Brown, J. R.
1412
Brown, K. L.
2583
Brown, L. C.
1920, 1921, 1923-1925, 1927-1929
Brown, P. J.
373, 375
Brown, R. D.
48
Brown, R. G.
738
Brown, R. M.
1479
Brown, S. C.
1425, 1437, 1471, 1529, 1541, 1546, 1549, 1550, 1558, 1769, 1770
Brown, W. F., Jr.
1674
Bruce, V. G.
2225, 2227
Brucker, E. B.
1042, 1043, 1051, 1054, 1055
Bruland, H.
1961, 1962, 1966-1968
Brundin, C. L.
310
Bruner, J.
1164, 1165A, 1167
Bruniak, R.
2739
Bryant, C. D.
738
Bryntse, R.
2807
Buchsbaum, S. J.
1769, 1770
Buchthal, F.
537
Bucy, R. S.
2380
Budini, P.
2784
Buechner, W. W.
1364, 1368, 1372, 1383
Buehler, R.
1783
Bufalini, M.
61
Bugnole, D. S.
507, 508
Bulloff, J. J., ed.
94, 95
Bumiller, F.
2591, 2592
Burch, N. R.
96, 97
Bureau, F. J.
1097-1099
Burgdorfer, A.
687

Author Index

Burgers, J. M.
1267, 1270, 1274
Burgess, D. S.
197
Burke, E. R.
1279
Burkhardt, H.
2565
Burkhart, R.
476
Burleson, G. R.
2578, 2589, 2594
Burnham, D. C.
889, 895
Burns, J.
424
Burnstein, E.
1629-1632, 2757
Burstein, S. Z.
2164
Burtch, F. W.
1940
Burwell, R. L., Jr.
1885
Buser, P.
1150, 1151, 1157, 1158, 1164-1166, 1168, 1169
Buss, L.
2570
Butler, L. G.
1942
Bydalek, T. J.
2288
Byers, N.
2549, 2557, 2565
Byfield, H.
2652

Cabezas, A. Y.
273
Cagnon, M.
2001
Cahill, J. A.
2741
Caianiello, E. R.
1197, 1202, 1744
Calcote, H. F.
10
Callahan, D. A.
913, 916, 920
Calderón, A. P.
434, 435
Caldwell, D. O.
1399
Cambel, A. B.
1881
Cameron, A. G. W.
227
Camm, J.
79
Campbell, E. S.
1781-1784
Campbell, H. J.
1571
Campbell, R. M.
1910, 1916
Campolattaro, A.
1197
Canut, M. L.
1145, 1147, 1148
Caprioglio, G.
1652-1655
Carlin, H. J.
2168
Carlos de Mello, W., ed.
149
Carlson, A. W.
716, 717
Carlsson, A.
1131
Carlstrom, D.
1067
Carpenter, D. L.
2626
Carpino, L. A.
1568
Carr, H. E.
604
Carrington, A.
1703
Carter, C. F.
1589-1591
Carter, D. L.
511, 512
Carter, E. B.
660
Cassl, E.
1657
Cassidy, H. F.
711
Castellan, G. W.
412-415
Castellano, S.
1547
Castelli, V.
688
Cattorini, M.
1660
Cavanaugh, J. R.
505, 506
Cayrel, R.
221, 228, 229
Celli, V.
874
Cesari, L.
2364
Chadan, K.
1190
Chagas, C., ed.
148
Chahine, M. T.
317
Chaiken, R. F.
28, 32
Chakravarti, I. M.
1862, 1864
Chambers, R. W.
901
Champlin, K. S.
1681, 1682
Chandaket, P.
361-363
Chang, C. C.
1677-1679
Chang, I.-D.
201, 202

Chang, S. S. L.
1788, 1790, 1791, 1793
Chantry, G. W.
560, 561, 563
Charatis, G.
1621
Charney, H. R.
2172
Chaudhuri, see Ray-Chaudhuri
Chen, F.-S.
1917
Chen, M. M.
1332
Chen, R. L. W.
2685
Chen, Y. W.
2923, 2924
Cheng, H. K.
542
Cheng, S.-I.
2217
Chern, S.-S.
436, 1095
Chernoff, H.
2510
Cheselske, J. F.
32
Chesler, D. A.
1468
Chew, G. F.
253, 257
Chiarotti, G.
2010
Chicago U. Lab. of Molecular Structure and Spectra.
468
Chien, R. T.
915
Childs, C. B.
1849
Chinitz, W.
647, 2352
Chitnis, E. V.
1377
Cho, B. Y.
1929
Chodorow, M.
2604
Choi, S.-I.
184
Chomsky, N.
1473
Chopra, K. P.
2154, 2160, 2161, 2479
Chow, L. Y.
3027
Chow, W. L.
924, 925
Chowla, S.
1866
Chraplyvy, Z. V.
2453
Christiansen, J.
535, 536
Chrusciel, T. L.
1985
Chu, B.-T.
2357
Chu, C.-C.
2466
Chu, E. L.
2600
Chuan, R. L.
2483, 2487
Chung, K. L.
2670-2673
Ciaranfi, E.
1656
Cicala, G. A.
2244
Cindro, N.
1361, 1365, 1379, 1407
Ciola, R.
1885
Clark, G.
1377
Clark, J. S.
2825
Clark, J. W.
2877
Clark, K. C.
2910
Clark, L. F.
1560
Clark, W. A.
1479
Clark, W. H.
2828
Clarke, F. R.
1615
Clauser, F. H.
1021, 1761
Clauss, F. J., ed.
44
Clay, R. B.
2833
Clifford, A. F.
2283, 2286
Clifton, Y. H.
1308
Cobb, W.
1868, 1869
Cochran, E.
1064
Cochran, J. F.
1504, 1517
Cochran, P.
1504
Coe, W. B.
2356
Cohen, I. M.
2212
Cohen, P. J.
943
Cohen, S. G.
819
Cohen, S. I.
620-624
Coldwell-Horsfall, R. A.
1214
Coleman, B. D.
1579-1582
Coleman, C.
2363
Coleman, P. D.
902, 904, 905, 907

Author Index

Collingwood, E. F.
1619
Collins, J. F.
1972
Colvin, R. S.
2617
Combustion Inst., Pittsburgh, Pa.
526, 527
Condit, R. H.
2249, 2252
Conner, P. E.
2844, 2847, 2849, 2851
Constabaris, G.
2908
Conte, S. D.
1304
Conticelli, M.
1013
Cook, C. J.
2497
Cook, L. F., Jr.
2256
Cook, M. A.
2832, 2833
Cooke, W. D.
564
Cooper, A. J.
2767
Cooper, R.
189
Cooper, S.
423
Copaulsingh, K.
2667
Copeland, B. K. W.
69
Copeland, L. E.
844
Corbeels, R.
1115
Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.
578
Corrsin, S.
1033
Corsten, L. C. A.
1855
Cortese, C.
989, 990
Coryell, C. D.
1374
Cost, J.
870
Costa, G.
1363
Cowan, J. D.
1515
Cowan, M. J.
630, 639
Cowan, P. L.
2207, 2208
Cowen, J. A.
1599
Cox, L.
2697
Cox, M. C.
2474
Craig, D. P.
1107
Crandall, S. H.
1321
Crane, H. D.
2641
Crannell, H.
2574, 2584
Crawford, J. A.
275
Crawford, J.
1638
Crayton, N.
456
Creamer, L. R.
900
Crocco, L.
2204
Crocker, G. H.
1604
Croissiaux, M.
2591, 2592
Cronly-Dillon, J. R.
1458
Cross, M., de
2812
Cross, P. C.
2902, 2903
Crowell, M.
2179, 2180
Crut, M.
1376
Cruz, J. B., Jr.
908, 917, 918
Cubicciotti, D.
2495, 2496
Cudaback, D. D.
2619
Cuevas, M.
464, 467
Culick, F. E. C.
1416
Curtis, P. C., Jr.
3001, 3003, 3005
Curtiss, J. H.
1586, 1587
Cutting, J. C.
1320, 1325
Cutting, W.
2531
Czyz, W.
777
Czyzak, S. J.
600-602

Dabbs, J. W. T.
1760
Dabora, E. K.
1605
Daehnick, W.
2881
Daen, J.
1266
Daiber, J. W.
551-553
Dailey, B. P.
499, 505, 506

Dames, R. T.
1304
Damiano, V. V.
681, 682
Daniel, T. B.
1648
Danyluk, S. S.
2336
Darby, J. B., Jr.
881
Da Riva, I.
960, 961
Dash, J.
1901
Dauenbaugh, C. E.
1662
Davidon, R. S.
188
Davidson, E. R.
928, 929
Davidson, G.
1357
Davies, J. A.
1213
Davis, D. T.
1917
Davis, H. L.
1931
Davis, J.
1879
Davis, J. R.
1091, 1092
Davis, L. W.
2595
Davis, M.
2349, 2350
Davis, R. H.
656, 658, 660, 665, 669
Dawber, K. R.
1453
Dawson, T. L.
1087
Day, T. B.
1192, 1193, 1195, 1196, 1200, 1208
de Acha, A. see Acha
Dean, C.
2121, 2123, 2126, 2127
Dean, L. W.
1486
de Boer, P. C. T. see Boer
de Branges, L. see Branges
Deckers, J. M.
2196
DeCoursey, P. J.
2994-2997
de Cross, M. see Cross
DeGuchi, Y.
2892
Delahay, P.
646
de Leeuw, K. see Leeuw
Delves, L. M.
1367, 1389, 1406
DePasquali, C.
883
De Santo, D. F.
1779, 1780
Deser, S.
142-147, 2261
de Shalit, A. see Shalit
Desoer, C. A.
280, 281, 285, 286
de Sola Pool, I. see Sola Pool
Dessy, R. E.
474
DeStaebler, H. C.
2580
De Tar, D. F.
2466
Detoni, S.
534
Detwiler, D. P.
50, 51
Deutsch, M.
1391, 1393, 1401
Deutsch, S.
2169
Devienne, F. M.
1576-1578
Devinatz, A.
2872
D'Ewart, B. B., Jr.
104, 105, 107
DeWitt, B. S.
1843-1845, 1847
Dexter, D. L.
2413
de Zafra, R. L. see Zafra
Diamond, H.
1625A, 1626, 1627
Diaz, J. B.
1255, 1257
Dickens, P. G.
1998
Dickinson, H.
2653, 2654
Dieke, G. H.
1056
di Francia, G. T. see Francia
Dilworth, C.
1387
Dimmock, J. O.
3028
Ditsch, L. T.
1719, 1720
DiVesta, F. J.
2697
Dixon, G. H.
1977
Dixon, P. A.
1243
Dobbins, R. A.
2204, 2205
Dohlman, G.
1110
Donaldson, C. du P.
33, 34
Donnay, G.
2042
Donnay, J. D. H.
2042, 2052
Donner, T.
2351
Dooling, J. S.
408

Author Index

Doran, D. G.
2504
Doran, P.
825, 827
Dorfman, D.
1633
Douglass, D. H., Jr.
1545
Douglis, A.
1174-1177
Dowben, R. M.
1893, 1894
Draper, N. R.
1850, 1851
Dravnicks, F.
1703, 1705, 1707
Dreesen, J. A.
393
Dreitlein, J.
2880
Drell, S. D.
2540, 2547, 2548, 2553, 2555
Dressler, R. F.
1799, 1805
Driest, E. R., van, ed.
43, 1829
Drougge, G.
35, 36, 39
Dubins, L. E.
432
Ducati, A. C.
2130, 2134
Duckworth, H. E.
1138, 1139, 1141
Dueño, B.
2271, 2272
Duffin, R. J.
396
Dulgeroff, C. R.
1831, 1832
Dulmage, A. L.
1149
Dumont, S.
821
Duncan, D. B.
1873
Dunkle, R. V.
299
Dunnington, F. G.
2446
Dupree, T. H.
1559
Dutton, D. W.
2526
Duvall, G. E
2502
Dvir, M.
807, 813
Dvoretzky, A.
800
Dwass, M.
1891
Dyer, H.
155
Dyrssen, D.
2430
Dyvik, F.
1907
Ebbing, D. D.
930
Ebcioglu, I. K.
1677, 1679
Eberstein, I. J.
2203
Ebisuzaki, R.
2955
Eck, T. G.
402, 403
Eckert, E. R. G.
1695
Eckhaus, W.
1334, 1341
Economos, G.
1342
Economou, N.
2917
Eden, M.
1474, 1494, 1510
Eder, G.
2838, 2840
Edmonson, R. B.
30, 31
Edrei, A.
2675
Edwards, D. K.
300
Edwards, O. S.
374
Edwards, W.
1624
Eggers, D. F., Jr.
2903
Ehlers, V. J.
270
Ehret, C. F.
1289
Ehrlich, G.
712
Eichholtz, F.
820
Eichhorn, R.
1692, 1693
Eisen, C. L.
2356
Eisenstadt, B. J.
2681
Ekman, G.
2657, 2659, 2661
Ekspong, A. G.
2811
Eisner, M.
2744-2746
El Baroudi, M. Y.
2769
Elder, E.
349
Eldredge, N.
2531
El Kabir, D. J.
1573
Elleman, D. D.
1921-1924, 1927, 1928
Ellis, R.
2072
Elmqvist, D.
1119, 1121

Elrod, H. G., Jr.
687, 688
El-Sayed, M. F. A.
653
Emerson, M. T.
651, 652
Emmons, H. W.
739
Enderby, C.
907
Enge, H. A.
1364, 1404
Engler, A.
2405
English, J., Jr.
3035, 3036
English, R. L.
2885
Engström, A.
1066, 1068, 1070
Engström, I.
2797
Epley, D. L.
912
Epstein, R.
2983
Epsztein, B.
2175
Ercoles, A. M.
998, 1004, 1007, 1015
Erickson, W. C.
2400
Ericson, T.
1370, 1388
Ernst, F. J.
514
Ernsthausen, W.
2730
Escobar, I.
2455-2462
Espersen, G. A.
1834
Etkin, B.
2776, 2778
Evans, N. A.
2216
Everett, A. E.
782
Evleth, E. M.
2475
Ewald, A. W.
1902

Fabian, G. J.
547
Fabricius, E.
2789, 2790
Faeth, P. A.
2283, 2286
Fagg, L. W.
71
Fairbank, W. M.
3021
Fales, E. N.
70
Fallona, J. P.
2958
Fan, C. Y.
444-446, 450, 452
Fang, B. T.
1678
Fano, R. M.
1427
Farrell, R. F.
105
Fatiadi, A.
724
Faughnan, B. W.
1557
Faulkner, J. S.
1932
Faust, W.
492
Favero, P. G.
626, 628
Fay, J. A.
80, 1320, 1325
Federbush, P. G.
1358, 1362, 1394, 1397, 1398
Feenberg, E.
2886
Feil, D.
2120
Feinstein, B.
1731
Feit, W.
2076
Feld, B. T.
1363
Feldzamen, A. N.
439
Fellers, R. G.
2467-2469
Feng, P. Y.
835-837
Fenn, J. B.
1881
Ferguson, H. I. S.
2958
Ferrari, F.
258, 267, 268
Ferrell, R. A.
1218, 1220
Ferri, A.
2153
Ferro, A.
979-987, 992
Fetta, P. J.
322
Feurzeig, W.
2091
Feynman, R. P.
2004
Fichtel, C. E.
2883, 2884
Fife, P.
1804
Fine, M. E.
1901, 1902, 1904
Fine, N. J.
2074-2077
Fink, R. W.
2965
Finn, A. C.
1382

Author Index

Finn, E. J.
726
Fiorentini, A.
993, 1015
Fischer, F.
882
Fischer, R.
16
Fisher, L.
2449
Fite, W. L.
706, 708, 709
Fitzgerald, W. P.
2290
Flanders, P. J.
684
Fleischer, P. E.
1787, 1792
Fleishman, B. A.
2348
Fletcher, J. G.
2269
Flippen, R. B.
1751
Floreen, S.
1608
Flournoy, J. M.
11-13, 15
Floyd, E. E.
2844, 2847, 2849
Flügge-Lotz, I.
2566, 2567
Foa, U. G.
973, 976-978
Foner, S.
811
Fontana, J.
2607
Fontana, P.
3014
Foreman, K. M.
2352, 2355
Forestier, G. M.
1576
Forrer, M. P.
2601
Forrester, A. T.
1832
Forsbergh, P. W., Jr.
1346
Forsyth, J. B.
374, 375
Fortier, C.
98-102
Fowler, A. B.
741
Fowler, M.
381
Fowler, R. C.
1944-1946
Fowles, G. R.
2498, 2503, 2504
Fox, J.
2179, 2180
Fox, R. E.
2979
Fraenkel, G. K.
501, 503, 504
Fraga, S.
470
Frahn, W. E.
659
Frances, A. S.
515, 520
Franchel, H.
1166
Francia, G. T., di
996
Francis, M. P.
338
Frank, P.
2668
Fraser, P. A.
2949, 2954
Frauenfelder, H.
883-885
Frautschi, S. C.
2560
Frazee, J. D.
2748
Fréchette, V. D.
1762
Fredericks, W. J.
2497, 2499
Freedman, E.
551, 553
Freeman, A. J.
1329, 1409-1411
Freeman, J. M.
1392
Freise, E. J.
1903, 1904
French, F. W.
2146
Frenkiel, F. N.
1758
Frenzel, C. A.
193
Fribourg U. Dept. of Physics (Switzerland).
702
Friedlander, M. W.
2884
Friedman, E.
808, 809
Friedman, H. M.
2092, 2093, 2101
Friedman, J. I.
2572, 2573, 2582
Friedman, R.
68, 71, 73
Friedrichs, K. C.
1805
Frisch, D. H.
1360
Frisch, H. L.
3037-3039, 3043, 3044
Frisk, A.
2811, 2822
Fritzsche, H.
464-467
Fronsdal, C.
2693, 2696
Frueh, F. J.
106
Frye, G.
255, 258, 264, 267, 268

Fu, K. S.
910
Fu, Y.-C.
2836
Fuchs, R.
1351
Fuchs, W. H. J.
2674, 2675
Fujii, A.
2298
Fujimura, O.
1485, 1524
Fujisaki, H.
1522, 1525
Fujita, J.-I.
2554
Fujita, S.
1238
Fukunaga, T.
1913-1915
Fulrath, R. M.
324
Fung, Y. C. B.
200
Furlong, R.
409

Gabel, P. V.
2417
Gadamer, E. O.
2773
Gajewski, R.
1563
Galasyn, V.
863
Galatry, L.
3018
Gale, C. C.
2094
Galeano, C.
951, 952
Gallo, P. S.
369
Gamboa, J. M.
957, 958
Garcia-Austt, E.
956
Garcia-Colin, L. S.
1239, 1240
Garcia de la Banda, J. F.
959
Garcia, E. E.
674
Garg, J. M.
2185
Garik, V. L.
2176
Garland, C. W.
1502, 1553
Garofalo, A. M.
714
Garsia, A. M.
1310, 1311, 1688, 1689
Gartenhaus, S.
2304
Gastaut, H.
1171
Gatto, R.
260
Gauld, C.
2664, 2666
Geisler, C. D.
1531
Gelbaum, B. R.
1684, 1685
Geller, I.
28
Geller, K. N.
2081-2083, 2086
Gell-Mann, M.
2004
Generay Dynamics Corp. Convair Div., San Diego, Calif.
705
General Dynamics Corp. General Atomic Div., San Diego, Calif.
707
Genovese, F.
1395
George, D. L.
615, 618
George, M. D.
1247
George, R.
1571
Gersholm, T. R.
2814
Gerstein, G. L.
1492, 1516, 1527
Geschwind, N.
2837
Gesteland, R. C.
1444, 1534
Getty, W. D.
1530
Ghai, M. L.
711
Gibson, W. E.
546
Giedt, W. H.
319
Gigli, A.
721
Giguère, P. A.
1094
Gilbert, E. E.
2064
Gilbert, W.
142, 143
Gildart, L.
1090
Gillman, L.
2074
Ginoux, J. J.
2780-2782
Giordmaine, J. A.
484, 487, 510
Girardeau, M.
138, 141
Giuliani, G.
2010
Glarum, S. H.
185, 186
Glaser, V.
1220

Author Index

Glass, A. J.
2393
Glasser, F. P.
4
Glasser, L. S.
4
Glassman, I.
2203, 2204, 2206
Glauber, R. J.
773, 775, 782-785
Glick, A. J.
1218
Glicksberg, I.
2505-2507
Glicksman, M.
2314
Gluckstern, R. L.
3024, 3025
Gnanadesikan, R.
1860
Goblick, T. J., Jr.
1463
Goffman, W.
2969
Gold, A.
2414, 2415
Goldberg, A.
2217, 2539, 2563
Goldberg, J.
2998
Goldberg, J. M.
440, 443
Goldberg, R. R.
1886-1888
Goldberg, S. I.
2920-2922
Goldberger, M. L.
2254, 2257, 2258, 2268
Golde, H.
2609
Goldfarb, T. D.
232
Goldhamer, D. L.
2292
Goldsborough, J. P.
2533, 2534
Goldstein, M.
2173
Goldstein, M. H.
2119
Goldstein, M. H., Jr.
1449, 1450, 1526
Goldstein, M. S.
2340
Goldstein, R. J.
175
Golian, T. C.
543, 545
Gollnick, A. F., Jr.
1417
Good, W. D.
195
Goodkin, J.
2335, 2337
Goodman, T. R.
56
Gopaulsingh, K.
2665
Gordon, G. D.
2313, 2317
Gordon, W. L.
402, 403
Gordy, W.
627, 629-634, 636, 637, 639, 641, 642
Gorin, G.
1941, 1942
Gorman, C. D.
2999
Gorum, A. E.
327
Gosselin, R. P.
530, 531
Gottfried, K.
769, 777
Gottlieb, H. B.
476
Gottlieb, P.
1518
Gotto, A. M.
1979
Gould, R. D.
1998
Gould, R. K.
161
Gourary, B. S.
1217, 1233
Gourdin, M.
2006
Gourdine, M. C.
2131, 2132
Grabowski, Z.
2813, 2818, 2819
Gram, P. A. M.
2582
Granet, I.
2353
Grannen, E., Jr.
474
Graves, T.
2097
Gray, C. T.
1975
Gray, E. P.
1040, 1041
Gray, T. J.
49, 53-55
Greber, I.
1337
Greco, C. V.
674
Green, D. M.
1509, 1521
Green, J. L.
2301
Green, J. R.
1777
Greenberg, B. G.
1859
Greenberg, J. S.
3023
Greene, E. F.
187
Greene, P. H.
425
Greenlees, G. W.
2447

Greenspan, H. P.
1315, 1316
Greenstein, J. L.
217, 219
Gregg, L. W.
398
Greiner, T. H.
97
Griffing, V.
409-411
Griffiths, R. B.
2537
Grimes, D. M.
1625
Grinninger, L. D.
1088
Grisaru, M. T.
2258
Grodzins, L.
1395
Groot, J. de
98
Gross, B.
2191
Gross, E. P.
137, 139, 140
Gross, G. L.
1336
Gross, R. A.
647
Grossmann, S.
699
Grosswald, E.
938
Grove, E. L.
46-48
Grover, J. H.
70
Grow, R. W.
2825-2828
Gruber, S.
1491, 1551
Grumer, J.
197
Grünbaum, B.
795, 933, 935, 938-940
Grünthal, E.
108
Grunwald, E.
650-652
Gualtierotti, T.
1658-1660
Guerriero, L.
1380, 1390
Gugliotta, F.
2284
Guillemin, E. A.
1470, 1478
Guinier, A.
2001
Guman, W. J.
2353
Gunson, J.
379, 380, 385
Gurian, B. S.
1287, 1291
Gurland, J.
971, 972
Gustafsson, S.
2813, 2819
Guttman, L.
974-976
Guy, C. W., ed.
43
Guy, D. L.
2865
Guyard, R.
2079

Habert, R.
2221
Hadjiioannou, T. P.
865
Haering, R. R.
1143
Hager, H.
1575
Hager, L. P.
1981
Hagström, S.
2816, 2817
Hahn, B.
703
Haime, F.
429
Haimo, F.
2867, 2868
Hakimi, S. L.
917
Hale, J. K.
2368, 2374
Hale, R. W.
580
Halfin, S.
793, 801
Hall, J. G.
543-545
Hall, K. P.
2209
Hall, R. B.
1446
Hall, W. J.
1874
Halle, M.
1429, 1475, 1510
Haller, K.
2987
Halpern, F. R.
2257
Halpern, J.
2081, 2082
Halsey, G. D.
2907-2909
Halvorson, H. O.
2982, 2984
Hama, F. R.
1276-1279
Hamilton, D. R.
2980
Hamilton, J.
383
Hamilton, J. B.
837
Hamilton, J. D.
2645

Author Index

Hamlet, Z.
2475
Hammaker, G. S.
1884
Hammerling, P.
76
Hammitt, A. G.
2210, 2214, 2215
Hammond, G. S.
198
Hampson, R.
408
Hanafee, J. E.
876
Hance, A. J.
1285
Hand, L. N.
2586
Handelman, G. H.
2343, 2345-2347
Handler, P.
953, 956
Hanes, M. H.
926
Hannah, B. O.
660
Hano, J.
1095
Hansberger, I. M.
674
Hansen-Nygaard, L.
533
Hanson, R. L.
1717, 1721
Hanson, H. G.
604
Hanson, R. C.
890
Hara, T.
722
Harary, F.
1635
Hardwick, E. R.
346
Harish-Chandra,
509
Harris, A. B.
742
Harris, F. S., Jr.
2835
Harris, G. W.
1570, 1571
Harris, H.
2242
Harris, R. T.
616
Harrison, A. C.
2071
Harrison, P. G.
49
Harrison, W. A.
713
Harrop, R.
2077
Hart, V. G.
539
Harteck, P.
2342
Harth, E. M.
1050, 2698-2700
Hartman, P.
1026-1031
Hartunian, R. A.
549
Harvard U. Dept. of Mathematics, Cambridge, Mass.
757
Harvey, K. B.
1094
Harwit, M.
1497, 1540
Hassel, O.
1951, 1952, 1954, 1955
Haste, G. R.
2852
Hattori, K.
843
Haus, H. A.
1554
Hause, A. D.
1505
Hayday, A. A.
1695
Hayes, W. D.
1748, 1749, 2218
Haymes, R. C.
1825
Hecht, G. J.
306, 308
Heck, D. L.
1856
Heideger, W. J.
2201
Heinz, J. M.
1523
Heiser, W. H.
212
Helfand, E.
3037, 3038, 3040, 3043
Helfer, H. L.
224, 2400, 2401
Helium Bubble Chamber Collaboration Group
1052, 1053
Heller, G. I.
2370
Hellerstein, S.
2674
Helliwell, J. B.
2420, 2422
Helliwell, R. A.
2621, 2624, 2625, 2629-2631
Helliwell, T. M.
225
Helm, R.
2574, 2584
Hendricks, C. D., Jr.
2766
Hendry, D. G.
964
Herbert, A.
2661
Herman, M.
678-680, 683
Herman, R.
3019
Hermann, R.
1699, 2151

Herrick, S.
335-338, 340-342
Herrmann, G.
524, 524A
Herrmann, R.
1700, 1701
Hersh, C. K.
847
Hersil, J.
2457
Herstein, I. N.
2075
Hertzberg, A.
544
Hexter, R. M.
1583-1585
Hicks, B. L.
857
Higasi, K.
2245
Hight, S.
2210
Hill, D. A.
1399
Hill, G. R.
2836
Hillarp, N. A.
1123, 1126, 1128, 1129
Himmel, L.
321, 326
Hinde, R. A.
389, 390
Hirao, T.
2106, 2109, 2116, 2117
Hirota, N.
2895
Hirsch, H. R.
1480, 1535, 1539
Hirsch, M. W.
941, 942
Hirsch, P. B.
376
Hirschberger, W.
1575
Hirschman, I. I., Jr.
2866, 2869-2871
Hirshfield, J. L.
1441, 1490, 1529, 1549, 1550, 1558, 1563
Ho, Y.-C.
745
Hobart, R.
877
Hoch, G.
2392
Hochstadt, H.
1807
Hoeffding, W.
1852, 1872
Hoenig, S. A.
316
Hoff, M. E.
2639
Hoff, N. J.
2521, 2522, 2525, 2712
Hoffman, B. F., ed.
149
Hoffman, K.
1296
Hofmann, D.
2987
Hofmann, F. W.
635
Hofstadter, R.
2589, 2591, 2592
Hoijtink, G. J.
2894
Hold, A.
2839
Hollahan, J. R.
1708
Houshouser, D. F.
923
Holt, M.
154, 169, 170
Holter, Ø.
1959
Honig, A.
2683, 2684
Honig, C. R.
2417
Honig, J. M.
2285
Hood, C. B.
1918
Hooker, W. W.
244
Hooper, J. W.
735
Hope, H.
1951, 1953
Horstein, M.
1507, 1511
Hoshino, S.
2060
House, A. S.
1522
Howland, B.
1444, 1534
Hsieh, H. C.
355, 365
Hsiung, C.-G.
1095
Hsu, P. T.
1332
Hu, A. S. L.
2983
Hu, S.-T.
2926, 2927, 2929
Huang, K.
1378
Hubel, D. H.
793
Huber, E. A.
859
Hucke, E. E.
1607
Hudda, F. G.
712
Hugelin, A.
821
Hugentobler, E.
703
Hughes, G.
603
Hughes, R. H.
63-66

Author Index

Hughes, V. W.
3026, 3027, 3029-3033
Hull, R. J.
1537
Hultgren, R.
328, 330
Hung, J. C.
1786, 1789
Hunsberger, I. M.
672, 673
Hunt, J. M.
2636
Hunt, R. P.
1350
Hurlbut, F. C.
320
Hurley, J. P.
2891
Hutcheon, I. C.
2767
Hwang, C. F.
1726
Hyman, G. E.
406

Ikeda, S.
1713
Illinois U. Dept. of Physics, Urbana.
897
Imamura, T.
1848
Imbert, M.
1158, 1163, 1168
Inchauspé, N.
891, 893
Ingerman, P. Z.
2088, 2089
Irons, E. T.
2088, 2089, 2091
Isaacs, J. P.
1037
Isenor, N. R.
1138, 1139
Ishikawa, T.
2648
Isihara, A.
2181, 2182
Ivy, A. C.
866

Jackson, F. J.
157, 159, 160
Jackson, L.
1765
Jackson, T. W.
736
Jackson, W. D.
1533
Jacobs, T. A.
204, 205, 210
Jacobson, N
3008, 3009
Jacobson, R. A.
1710
Jacobson, R. L.
720
Jacox, M. E.
1585
Jaggi, R. K.
1241
Jahn, R. G.
211, 215
Jakimovski, A.
799
Jakobsen, J. F.
1729
Jamba, D. M.
2763
James, D. W.
2337
James, I. M.
238, 239
Jancovici, B.
2007
Janes, G. S.
81, 83
Jansen, J., Jr.
1964, 1969
Jansson, A.-M.
2769
Janusz, T. P.
1345
Janz, G. J.
2333-2337
Jardetzky, O.
1706
Jarmain, W. R.
2946, 2947, 2953, 2955
Jarre, G.
2139
Jarrell, D. L.
1373
Jaunzemis, W.
2018, 2019
Jaynes, E. T.
2601
Jeffrey, G. A.
2120
Jennings, K. R.
1999
Jensen, E.
1958
Jepsen, D. W.
1244
Jesperson, G. K.
2829
Johansson, B.
1826
Johansson, G.
2429
John, F.
1803
Johns, T. R.
1121
Johnson, C. A.
323
Johnson, C. S., Jr.
1552
Johnson, D. M.
1149
Johnson, G.
2394
Johnson, H. L.
736

Johnson, K.
1381, 1402
Johnson, K. A.
1394
Johnson, N. L.
407
Johnson, W. E.
1194
Johnston, T. W.
2311
Johnston, W. A.
2863, 2864
Jolliffe, K. H.
1199
Jones, E. D.
2914
Jones, F. C.
453
Jones, L.
423
Jones, L. V.
1876
Jones, R. V.
743
Jory, H.
295
Joseph, A. S.
402, 403
Jovanovich, J. V.
2891
Joy, H. W.
347
Junge, K.
2659
Jurkat, W. B.
2679
Jurna, I.
1077
Jury, E. I.
283, 284, 288-291
Just, K.
701

Kaada, B. R.
1961-1963, 1965-1968, 1970, 1971
Kacmarek, A. J.
842
Kadanoff, L. P.
783
Kadesch, R. R.
2825, 2828
Kaesz, H. D.
787, 788, 792
Kahane, J. P.
867
Kahn, D.
2393
Kailath, T.
1460, 1496, 1508, 1519
Kalisch, G. K.
1683
Källén, G.
1210
Kallmann, H.
613, 1820
Kalman, G.
2724
Kalman, R. E.
2380-2382, 2385-2387
Kanazawa, A.
2306
Kandler, V. O.
2731
Kaplon, M. F.
2403-2406
Kaprielian, Z. A.
2476, 2477
Karabatsos, P. J.
650
Karn, H. W.
398
Karni, S.
909, 921
Karni, Z.
2709
Karplus, R.
263
Karvinen, E.
666
Kasha, M.
653
Kaskel, A. L.
584
Kassner, J. L.
45, 46
Katchalski, E.
2937
Kato, T.
1798
Katz, A.
2938, 2939, 2942
Katz, J. M.
2597
Katz, T. J.
500
Kaufman, A. N.
278
Kaufman, I.
902
Kaufman, J. J.
1022
Kay, M. I.
2070
Keech, D. B.
1982
Keffer, F.
2122, 2125
Keller, H. B.
1806
Keller, J. B.
1810, 1812, 1814
Kelly, A.
1895, 1903, 1904
Kelly, G. V.
541
Kelly, W. H.
1594-1596
Kemp, J. C.
292, 293
Kemp, N. H.
78
Kenan, R. P.
1930

Author Index

Kendall, H. W.
2571-2573, 2578, 2582
Kendall, W. B.
330
Kennedy, J. H.
2972
Kennet, H.
1333
Kenney, M. E.
400, 401
Kent, A.
2967
Kent, R. L.
1456
Kerman, A. K.
1400
Kern, J.
2820
Kerr, D. E.
1038-1041
Kerrebrock, J. L.
213, 214
Kestin, J.
171-174
Key, B. J.
129
Keyes, R. T.
2831, 2832
Khuri, N. N.
2255
Kiang, N. Y.-S.
1449, 1450, 1495, 1516, 1560, 1566
Kidder, J. N.
3021
Kikuchi, C.
1639, 1640, 1642-1645
Kildal, A.
1957
Kilkson, R.
2915, 2916, 2919
Killam, K. F.
1285
King, I. R.
2742, 2743
King, J. G.
1543
King, R. B.
792
King, R. M.
1840
King, R. W.
2300. 2305
Kingsley, J. D.
886-888
Kino, G. S.
2598
Kip, A. F.
279
Kirk, E. S.
554
Kirkaldy, J. S.
1143
Kirkpatrick, H. B.
1748-1750
Kirshenbaum, A. D.
2741
Kivel, B.
70, 79
Kizilos, B.
1670
Kjellberg, R. N.
1292
Kleber, E. V., ed.
231
Klein, H. M.
2494
Klein, L.
3013, 3014
Klein, P. R.
1365
Kleitman, D. J.
779, 784
Kline, S. J.
2530
Knable, N.
857
Kniffen, D. A.
2897
Knight, J. M.
1199
Knoll, J. S.
2978, 2979
Knox, R. S.
889
Knudsen, A. W.
703
Knuth, D. E.
1864
Kobayakawa, S.
2162
Kodama, S.
287
Koga, T.
2478, 2488, 2490-2493
Kogan, A.
2710
Kogelnik, H.
1990, 1993
Koh, S. S.
2925, 2928
Kohin, B. C.
1211
Kohin, R. P.
1185
Kohler, R.
1481
Kohler, R. H.
1536, 1548
Kohn, H.
635
Kok, B.
2392
Kolmodin, G. M.
1073
Kolthoff, I. M.
1713
Kooi, C. F.
2597
Koppleman, W.
1307
Korff, S. A.
1823-1825
Kornberg, H. L.
1972, 1973, 1975-1981
Kornblum, N.
2291

Koros, R. M.
2196
Korringa, J.
1930, 1932
Korst, H. H.
924, 925
Koski, W. S.
1022-1024
Kosower, E. M.
2985-2988
Kostant, B.
241
Kösters, B.
2859
Kotik, J.
2702
Kotin, L.
463
Kowitt, F. R.
1724
Kraai, D. A.
1608
Krabbe, G. L.
2294, 2295
Kraichnan, R. H.
1813
Kraihanzel, C. S.
2992
Kramer, H. H.
926
Kreevoy, M. M.
1717-1724
Kregarman, J. J.
2756
Kreider, D. L.
1313
Kretschmer, C. B.
25, 26, 30, 31
Kreyszig, E.
1919
Krieger, I. M.
694
Krisher, L.
486
Kristiansson, K.
1134, 1135
Krongard, R. R.
1681
Krotoszynski, B. K.
835
Krstanovic, I.
2062
Krueger, A. P.
331-333
Kruger, L.
1170
Krumhout, R. A.
651
Krumme, J. B.
1938
Kuebler, R. R., Jr.
1854
Kuethe, A. M.
1604, 1628
Kuhlmann-Wilsdorf, D.
2079, 2080
Kuivila, H. G.
1767, 1768
Kunen, A. E.
2360
Kunnapas, T.
2660
Kunze, R. A.
1303
Kurita, Y.
633, 641, 642
Kurzius, S.
2199
Kusch, P.
493, 495
Kussner, H. G.
1093
Kveim, O.
1965
Kyhl, R. L.
1498

Lacina, J. L.
195
Ladell, J.
1835-1838
Laderman, A. J.
304, 306-308
Lai, D.
2250
Lake, K. J.
2989
Lam, S. H.
585
Lamb, J. C.
1037
Lambe, E. D.
2890
Lambe, J.
1641, 1643, 1644, 1646
Landahl, H. D.
427
Landahl, M. T.
35, 37, 39
Landshoff, P. V.
381, 382
Lanza, G.
1880
Laporte, O.
1622
Lapp, M.
203, 208
Lardner, R. W.
381, 386
Lardner, T. J.
2146
Larsson, B.
2788, 2790, 2791, 2793
LaSalle, J. P.
2361, 2362
Lascelles, J.
1978
Lashinsky, H.
482
Laskar, A. L.
878
Laskowski, D. E.
241
Lauria, A.
2273

Author Index

Lauria, F.
1745
Laurita, W. G.
1024
Lautenschlager, E. A.
1897, 1905
Lawhead, R. B.
1830
Lawson, A. W.
460, 461
Lawyer, C. B.
598, 599
Leaf, B.
692
Lebowitz, J. L.
3037-3045
Lee, Y. W.
1428
Lees, L.
1231
Lees, M.
237, 934, 936, 937, 943-946, 948
Leeuw, K. de
2506
Lefschetz, S.
2228, 2365
Legvold, S.
965-970
Leidenfrost, W.
171, 172
Leisenkotter, I.
2731
Leiser, M.
2688
Leitner, J.
2698-2700
Leivo, W. J.
1938
Leksell, L.
2793
Lemmer, R. H.
659
Lenard, M.
576
Lenchek, A. M.
1226, 1228
Lendaris, G. G.
289
Lenning, G.
2658
Lennox-Buchthal, M.
537
Le Noble, W. J.
2291
Leondes, C. T.
355, 357, 361-363
Leone, F. C.
404-406
Leslie, F. M.
1317
Lettvin, J. Y.
1421-1423
Levine, W. G.
1988, 1989
Levin, L. W.
2352
Levi-Setti, R.
457
Levitt, R.
2683
Levy, J. B.
68, 69, 73
Lèvy, M.
2004, 2008
Lewis, D. C.
2369
Lewis, D. C., Jr.
2375
Lewis, M.
3016
Lewis, M. B.
3011
Lewis, P. A.
1939
Lewis, R. M.
1811, 1814-1816
Li, H.
2011, 2012
Li, K. K. Y.
1561
Li, N. C.
2431
Li, S. C.
2198
Li, T. Y.
2319, 2320, 2322, 2323
Libby, W. F.
347-351
Libretti, A.
2464
Lichten, W. L.
488, 490, 492
Lichtenberger, W. W.
860, 861
Lichtman, S.
2698
Licklider, J. C. R.
131, 132
Lieber, E.
597-599
Lillo, J. C.
2390
Lim, M.
2640
Limentani, S.
455
Lin, C. C.
1945
Lin, T. H.
352-354, 866
Lindenstrauss, J.
802
Linderberg, J.
931
Lindgren, E. R.
2423, 2424
Lindgren, I.
273
Lindner, C. N.
2561
Lindqvist, I.
2804-2810
Lindqvist, M.
1131
Lindskog, J. L.
2814

Ling, F. F.
2338, 2339
Linnett, J. W.
1999, 2000
Linvill, J. G.
2634
Lipkin, H. J.
2940, 2943
Lipperheide, R.
368
Lipscomb, W. N.
754-756, 1710-1712
Lishajko, F.
1074, 1075
Little, A. G.
2616
Littman, T. M.
1833
Liu, C. Y.
171
Livingston, R.
1704
Llewellyn, J. E.
58
Llewellyn, P. M.
817
Llopis, J.
957, 958
Lloyd, K. E.
2862-2864
Lobato, J. M.
27
Locke, S.
1802
Lockett, F. J.
614
Lodge, J.
1044
Loeb, A. L.
1484
Loewenstein, E. V.
1057, 1059, 1060, 1062
Logan, J. S.
2647
Lömo, T.
2112
Lomon, E. L.
1403, 1405
Long, D.
1667, 1670
Long Island Biological Assoc., Inc., N. Y.
1114
Longe, V. G.
1018-1019
Longini, R. L.
2981
Loos, H. G.
2128
Lorber, H. W.
2318
Lord, R. C.
1025
Lorentz, G. G.
2676-2682
Lovell, M.
2054
Low, E. F., Jr.
1801
Low, F. E.
1386
Low, W.
803-817
Lowbser, J.
485, 486
Lowdenslager, D.
2236
Lowell, R. C.
461, 462
Lowengrub, M.
619
Lowry, R. A.
2855
Luckey, D.
1359
Ludloff, H. F.
1779, 1780
Ludwig, G.
700
Luke, Y. L.
1647
Lumsdaine, A. A.
59
Lund, P.
1977
Lundberg, B.
1067
Lundgren, G.
2429, 2432
Lurio, A.
3034
Lustig, H.
884
Lybrand, W. A.
832, 834
Lynch, D. W.
2010
Lynes, L. L.
314, 316

McAlevy, R. F.
2207, 2209
MacCamy, R. C.
397
McCann, S. M.
2092-2101
McCarthy, J.
1483
McClintock, C. G.
369
McClintock, F. A.
1319
McColm, D. W.
3030, 3032, 3033
McCoyd, G. C.
2448
McCracken, K. G.
1371, 1384
McCulloch, W. S.
1433, 1454, 1472
McCullough, J. P.
193, 195, 196
McCullough, R. S.
972
McCune, J. E.
581, 588, 590, 594

Author Index

McCusker, C. B. A.
611, 612, 2666
McDaniel, E. W.
729, 730, 733-735
McDermott, M. N.
490, 492, 497, 498, 896
McDowell, M. R. C.
731, 732
McEachran, R. P.
2954
McGlynn, S. P.
649
McGrath, J. E.
829
McGrath, J. W.
1083-1086
Machlin, E. S.
1569
McIlroy, W.
2360
McIlwain, H.
1572
McIntyre, J. D. E.
2333
McKeon, J. J.
1877
Mackie, A. G.
2420
MacLane, S.
428, 429, 2868
McLaughlin, R. J.
1466
McLean, A. D.
469, 472
McMullen, R.
2120
McRae, A. V.
2757
Maeder, P. F.
180, 181
Maggio, T. E.
3036
Magnes, J.
2104
Magni, F.
2107, 2108, 2118
Magnusson, E. A.
1108
Magnusson, T.
1131
Mahan, B. H.
233
Mahanty, J.
1212, 1216
Mahowald, M.
2669
Makemson, M. W.
338, 343
Makhov, G.
1639
Malatesta, L.
1650, 1651
Maldonado, E.
2456
Maling, J. E.
2513, 2514, 2517
Malinoski, R.
2051
Malone, D. P.
3023
Mallart, A.
1161
Malliavin, P.
868
Mallory, M. L.
1596
Malme, C. I.
1432
Malmstadt, H. V.
865
Mancia, M.
2105, 2113-2115
Mandel, L.
2411
Mandel, M.
2533, 2534
Mandelstam, S.
252, 253, 256, 257
Manganello, T.
2030, 2044
Manhart, R. A.
2646
Mann, D. E.
1746
Mann, R. W.
1331
Mannella, G.
2342
Manville, S. M.
704
Maradudin, A. A.
1212, 1214, 1217, 1233, 1234, 1236, 1242, 1244
Marble, F. E.
212
Marcus, M.
150-153
Margenau, H.
3012-3014, 3017, 3019, 3020
Margerum, D. W.
2287-2289
Margiotta, J. F.
2632
Margolis, M.
360
Mark, H.
1390
Marklund, I.
2813, 2818, 2821
Marrone, P. V.
548
Marsel, C. J.
1778
Marston, C. H.
1331
Martin, D.
352
Martin, D. W.
729, 733, 734
Martin, P. C.
776
Martinek, F.
710, 711
Maryland U. Dept. of Physics, College Park.
1183
Mashhour, M.
2658

Massion, J.
1153, 1160
Matarrese, L. M.
1845
Mather, J. R.
606, 808-610
Mathiesen, O.
1132, 1133-1135
Mathieu, R. D.
2011, 2012
Matlin, A. H.
1634
Matsen, F. A.
2749, 2754
Mattox, D. M.
1089
Mattuck, A.
1301
Mattuck, R. D.
1442
Maturana, H. R.
1421-1424
Maurer, D.
240
May, F. C.
152, 153
Mayer, W. G.
1602
Mayor, L.
823-825, 827
Mazumder, B. R.
559
Mazur, P.
1098, 1232
Meaken, J. D.
685
Meek, J. S.
475
Mehlhop, W. A.
2890
Meijer, P. H. E.
417-422
Meisters, G. H.
2379
Melissinos, A. C.
2403, 2412
Melton, J. S.
2968, 2970, 2971
Melzack, R.
2107, 2108, 2118
Melzer, M. S.
2290
Mendelsohn, N. S.
1149
Merkes, E. P.
1892
Messerly, J. F.
194
Meulders, M.
1160, 2105, 2113-2115
Meyer, H.
742, 743
Meyer, P.
444-447, 450, 452
Meyerhoff, L.
844
Michael, R. P.
1570
Mikhail, W. F.
1858
Miles, P. A.
1355
Milford, S. N.
2448-2452
Millan, G.
960, 981
Miller, C. E.
1940
Miller, R. G.
2509
Miller, S. E.
87
Miller, S. I.
848, 849
Mills, R. L.
1930
Milne, T. A.
2494, 2498
Milton, A. S.
1987
Minas, S.
1933, 1934
Minc, H.
150, 151
Minkowycz, W. J.
1895
Minneapolis-Honeywell Regulator Co., Hopkins, Minn.
1663
Mirri, A. M.
828, 843
Mishkin, E.
2183, 2184, 2189, 2190
Misner, C. W.
144-147, 2281
Missouri U. Dept. of Mathematics, Columbia.
1728
Mitchell, G. E.
668
Mitchell, J.
2020
Mitchell, R. W.
2744, 2748
Mitchell, T. E.
376
Mitra, S. K.
286
Mitsui, T.
2063
Mittleman, M. H.
278
Mittlestadt, V. R.
1680
Miwa, T.
1915
Miyagawa, I.
633, 837
Miyamoto, K.
2407, 2410
Moeller, T.
883
Mohanty, G. P.
852, 853
Mojoni, A.
987, 988, 992
Mollica, A.
2112

Author Index

Molnar, C. E.
1434
Montalenti, G.
979-986
Montgomery, D. J.
1600, 1601
Montroll, E. W.
1232, 1234
Moody, M. F.
1106
Mooers, C. N.
3046
Moore, F. K.
546
Moore, J. C.
2234
Moore, N.
3015
Moore, T. E.
1940
Moran, J. P.
1414, 1415
Moreno, F. G.
962
Morgan, L. O.
747
Mori, F.
1001, 1009
Mori, G. F.
994, 997, 1006
Mori, Y.
592
Morita, M.
2298
Moriwaki, Y.
2178
Morris, I. L.
1484
Morris, S.
1405
Morrish, A. H
1675, 1676
Morrison, H. L.
410
Morrison, S. R.
1662
Morrissey, J. J.
2450
Morse, R. W.
162, 165, 167, 168
Mortimer, C. T.
1081
Moruzzi, G
21[illegible], 2110
Moser, [illegible]
[illegible]95
Mos[illegible], J. B.
1900
M[illegible]skowitz, S. E.
2159
Mostov, P. M.
2358, 2359
Moszkowski, S. A.
262
Motz, H.
1994
Motzkin, T. S.
763
Moulic, E. S.
315
Mower, L.
1739, 1770
Moyls, B. N.
150
Mozley, R. F.
2588
Müller, E. R.
2021-2025
Mueller, R. K.
720
Münch, V. J.
2736
Muirhead, E. G.
2081-2083
Mulliken, R. S.
469
Mulson, J. F.
2021
Mundy-Castle, A. C.
189
Munk, M. M.
416
Munkres, J.
2231-2233
Munson, P. L.
794
Muntz, E. P.
2772, 2774
Mura, T.
1897, 1898, 1905
Murad, E.
2398
Muray, K.
321
Murgai, M. P.
739, 740
Murthy, C. R. K.
1598
Myers, A.
165
Myerson, A. L.
2071
Mylonas, C.
182
Myron, S. M.
873
Mysels, K. J.
2474

Nachbar, W.
1104
Nachtrieb, N. H.
459
Nagamatsu, H. T.
2323
Nagasawa, M.
463
Nahabedian, K. V.
1766-1768
Nakamura, J. K.
609, 610
Nakaoka, M.
431
Naldini, L.
1651

Nambu, Y.
2267
Naphtali, L. M.
2163, 2164
Napolitano, L. G.
1736-1741
Narendra, K. S.
745
Nash, F.
512
Nash, W. A.
671
Neuberger, M.
2044
Nauenberg, M.
1403
Neame, J. H.
1560
Neff, W. D.
440-443
Nehari, Z.
396
Nehnevajsa, J.
515-522
Nelson, J. W.
670
Nelson, R. E.
1430
Nemytskii, V. V.
2228
Nerurkar, N. W.
2458, 2459, 2461
Nesbit, R. A.
358
Nettel, S. J.
1354
Neugebauer, C. J.
2273
Neuringer, J. L.
2359
Newcomb, P.
328
Newman, M. S.
1913-1915
Newnham, R. E.
1344, 1356
Newstein, M. C.
2701-2703
New York U. Inst. of Mathematical Sciences, N. Y.
1819
Neyman, J.
250
Nichol, J.
2761
Nicholls, J. A.
1605, 1606
Nicholls, R. W.
2945, 2948-2950, 2952, 2955, 2957-2964
Nicholson, R. B.
1903
Nicoletti, I.
1011
Nielsen, H. L.
666, 1366
Nielsen, J. T.
532, 535
Niemeyer, H.
1808
Niggli, A.
2065-2067
Nilsson, S.
2822
Nishimura, T.
282, 284, 288
Niu, H.-Y.
2990
Noble, V. E.
2930, 2933
Nocilla, S.
2136-2138
Noll, W.
395, 1579-1582
Nomura, K. C.
1665, 1666, 1668, 1669
Nordlie, P. G.
833
Norton, R. M.
840
Notario, Del
962
Notterman, J. M.
2243, 2244
Nottingham, W. B.
1436, 1448, 1512, 1528
Novick, R.
497, 498, 896
Nowak, E. J.
2199
Noyes, H. P.
253
Nudelman, C.
1781
Nussbaum, A.
1667
Nussbaum, A. E.
2872
Nutant, J.
1278
Nyborg, W. L.
155-158, 160, 161
Nyman, C. J.
562

Oaks, B. A.
2731
O'Bryan, H. M., Jr.
1610
Oehme, R.
2268
Oehmke, R. H.
1593
Oesterreich, R. E.
442
Ofer, S.
818
Ogawa, H.
245
Oguchi, T.
2122
Ohlsen, G. G.
2581
Ohring, M.
525
Okaya, A.
511-513

Author Index

Okaya, Y.
2057, 2060, 2062, 2064, 2068, 2069
Okubo, S.
1202
Olfe, D. B.
205, 206, 208
Olin, A.
2426, 2427
Olkin, I.
2511
Olsen, C. J.
2472
Olsen, T.
163, 164, 166
Olson, D. C.
2287, 2289
Oneda, S.
1189-1191, 1194
O'Neill, E. L.
1020
Oppenheim, A. K.
301, 302, 304, 305, 307, 309
Ordway, D. E.
580
Orey, S.
1686, 1687
Orlandini Kremenie, G.
959
Ormerod, F. C.
1110, 1112
Orr, W. H.
567
Orton, J. W.
1714-1716
Osborn, J. R.
2307, 2308, 2310
Oskam, H. J.
1680
Oskay, V.
177
Ostlund, E.
1076
Oswaldo-Cruz, E.
1154, 1159, 1162
Ottoson, D.
1071, 1072
Overbeek, J. Th. G.
2473
Owen, J. E.
400, 401
Ozaki, S.
1357

Pack, D. C.
2421
Paes de Carvalho, A., ed.
148, 149
Page, D. E.
611, 2244
Pai, M. A.
283
Pai, S. I.
1264
Paige, L. J.
3000
Paillard, J.
1172, 1173
Paillas, N.
821
Pake, G. E.
2528, 2532, 2535, 2538
Palfrey, T. R., Jr.
2303
Palmeira, R. A. R.
1371, 1384
Palmer, C. E.
351
Palmer, D. R.
1662
Palmer, E. P.
2827
Panofsky, W. K. H.
2580, 2590
Pantell, R. H.
2599
Papa, R. J.
1447
Papas, C. H.
199
Paré, V. K.
565
Paris, C. H.
1372
Parker, E. N.
454
Parker, E. R.
321-323
Parker, E. T.
1857
Parker, P. M.
1602, 1603
Parker, R.
219
Parker, R. A.
1752
Parkes, E. W.
2518-2520, 2524
Parkinson, W. H.
2945, 2962
Parkus, H.
2740
Parratt, L. G.
574
Parravano, G.
1609-1611
Parrish, W.
1837
Parriss, J. R.
1106
Parthasarathy, R.
1779
Pask, J. A.
326
Pass, H. R.
2480, 2486, 2489
Patel, S. A.
2147, 2149
Pati, J. C.
1189, 1194, 1204, 1205
Patrick, R. M.
74, 77
Patten, F.
632
Paul, D. A. L.
2875

Payne, H.
600-602
Payne, L. E.
1245, 1246, 1248, 1253, 1254, 1256, 1257, 1259
Peach, G.
731, 732
Peake, W. T.
1449, 1450, 1469, 1495
Pearlstein, L. D.
655, 657, 663
Pearson, J. J.
2124
Pearson, J. M.
1140
Peaslee, D. C.
2302
Peet, C. S., ed.
94, 95
Peixoto, M. C.
2383
Peixoto, M. M.
2383
Pendergast, R. J.
2454
Pendleton, C.
831
Penfield, P., Jr.
1477, 1544
Penfold, A. S.
1100-1103
Penfold, B. R.
755
Penner, S. S.
205, 207-209
Pennsylvania State U. Groth Inst., University Park.
2039-2041, 2043, 2053
Pennsylvania U. Dept. of Physics, Philadelphia.
2084, 2085
Peoples, R. G.
17, 18
Pepinsky, H. B.
1935, 1936
Pepinsky, P. N.
1935
Pepinsky, R.
2027-2038, 2044-2051, 2055-2062, 2064, 2066-2069
Percus, J. K.
3042, 3045
Peres, A.
2717-2723, 2725-2728
Peretti, J.
1240, 1273
Perez, P.
962
Perlmutter, A.
1589-1591
Perri, J. A.
2140
Perria, L.
723
Perry, H. F.
1046, 1048
Perry, J. W.
2967, 2969, 2972, 2974
Pershan, P. S.
744
Peter, M.
1457
Peterman, A.
2696
Petersen, F. R.
269, 271, 274
Petersen, H. L.
25
Peterson, G. E.
1635, 1637
Peterson, G. M.
1776
Petschek, H. E.
75
Petterson, W. W.
1462
Pettersson, B. G.
2815
Petticrew, R. W.
49
Pevsner, A.
1043, 1045, 1046, 1048, 1050
Pfeiffer, R. R.
1542
Pflumm, E.
1809
Philippot, J.
1235, 1237
Phillips, J. R.
788
Phillips, P. R.
2587
Phipps, J. A.
2855
Phizackerley, P. J. R.
1980
Pian, T. H. H.
1298
Pickard, W. F.
753
Pickford, R. S.
17-19
Picman, L.
769
Pierce, W. H.
2643
Pierson, W. R.
1374
Pike, E. R.
1455, 1517, 1838
Pilleri, G.
109-127
Pilström, G.
2801
Pimbley, W. T.
2021
Pimentel, G. C.
232, 234, 235
Pincock, R. E.
198
Piontelli, R.
2135
Pipkin, A. C.
1272
Piraino, D.
1372
Piranian, G.
1618, 1619
Pisa U. Inst. of Physiology (Italy)
2103

Author Index

Pitt, H. R.
2682
Pittendrigh, C. S.
2225-2227
Pitteway, M. L. V.
1532
Plane, R. A.
560-563
Plebanski, J. F.
366, 367
Pless, I.
1380
Plucknett, W. K.
1087
Plyler, E. K.
1063
Pohle, F. V.
2146
Poli, G.
2135
Polkinghorne, J. C.
378, 387, 388
Pollak, V. L.
2889
Polytechnic Inst. of Brooklyn, N. Y.
2141
Pomilla, F. R.
2449
Pompeiano, O.
2104
Pond, T. A.
2890
Pontinen, R. E.
1727
Poole, C. P.
1185-1188
Pope, M.
1820
Poplawsky, R. P.
2931, 2934
Popper, R. D.
832, 833
Porter, R. F.
555-557
Post, B.
2140
Post, I. G.
1920
Potter, R. F.
1751
Pozzi, A.
1737, 1740
Prager, S.
1725
Pratt, R. H.
449, 2544, 2550
Prepost, R.
3029, 3031
Pressman, W.
1812
Preston, M. A.
1140
Preziosi, B.
1197
Prigogine, I.
689, 694
Primakoff, H.
2876, 2880
Prodi, G.
2785
Protter, M. H.
242, 243, 246
Puff, R. D.
776
Pugh, A. C.
1704
Pugh, E. M.
393
Puotinen, D.
1356
Purdue Research Foundation, Lafayette, Ind.
2274
Purdue U. Jet Propulsion Center, Lafayette, Ind.
2309
Pursey, D. L.
366, 367
Pusterla, M.
258, 267, 268
Putnam, C. R.
2276-2282
Putnam, H.
2349, 2350
Pye, J. D.
1111

Quade, D.
1871
Quayle, J. R.
1974, 1982-1934
Quinlan, P. M.
538, 540

Raben, M. W.
2786
Rabin, E.
1830
Rabinowitz, P.
2936
Radbill, J. R.
20, 21
Radio Corp. of America. Astro-Electronics Div., Princeton, N. J.
2311
Radok, J. R. M.
2151
Rae, W. J.
577
Raman, K. R.
1628
Rangi, R. S.
2777
Ransil, B. J.
469-471, 473
Rao, V. S.
491, 494, 495
Rao Narasimha, D. V. G. L.
640
Rasetti, F.
1047
Rasmussen, E. W.
1965, 1966
Ray-Chaudhuri, D. K.
1865

Read, G.
2531
Read, T. A.
876
Reagan, D.
1991
Reames, J. P.
1440
Reboul, T. T.
2312, 2313, 2318
Redgate, E. S.
2975
Reeds, J. A.
1636
Reeves, E. M.
2951, 2956, 2957
Rehn, V.
2126
Reid, D. W.
2829
Reid, R. J.
611, 2665, 2667
Reiffel, L.
838-840
Reiffen, B.
1501
Reilley, C. N.
1839-1841
Reiner, A. S.
2941, 2944
Reiner, M.
2704, 2707-2709
Reinhart, B. L.
2373, 2376, 2378, 2384
Reiss, E. L.
1802, 1806
Reitz, D. C.
1705, 1707-1709, 2893
Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.
2354
Resler, E. L., Jr.
581, 590, 594
Rexroad, H. N.
629
Reynolds, C. A.
1064
Rhee, Y. I.
2699
Ribner, H. S.
2770, 2771
Ricci, G.
2418
Ricci, G. F.
2102
Rice, S. A.
460
Richardson, C.
2127
Richmond, J. K.
197
Rigden, J. S.
1023
Rigney, D. S.
2359
Rikmenspoel, R.
676, 677
Ring, L. E.
583
Ring, M. A.
2904, 2905
Ritter, D. M.
2904-2906
Ritter, H. L.
1592
Robbins, A. B.
2447
Robbins, P. B.
93
Robertson, W. W.
2751, 2752
Robinson, A.
796, 798, 801
Robinson, B. L.
2965
Robinson, D.
2950, 2964
Robinson, D. W.
1025
Robinson, I.
1846, 2687
Robinson, J.
2350
Rocha-Miranda, C.
1154, 1159, 1162
Rochester U. Dept. of Chemistry, N. Y.
2397
Rodberg, L. S.
1192
Rodemich, E.
1310
Rodrigue, G. P.
743
Röhrl, H.
1690
Rogers, H., Jr.
1313
Rogers, R. N.
2532
Roman, P.
2408
Rømming, C.
1952, 1954
Romualdi, J. P.
394
Ronchi, L.
993, 994, 996, 997, 999, 1001, 1002, 1005-1007, 1009-1011
Rose, D. J.
1487
Rose, E.
1775
Rose, W. G.
1034
Rosen, G.
1467
Rosen, N.
2718, 2722, 2723
Rosenberg, L.
972
Rosenblatt, J. R.
1853
Rosenblith, W. A.
1280, 1420

Author Index

Rosenlicht, M.
247
Rosner, D. E.
5-10
Ross, J.
193, 184, 1096
Rossi, G. F.
722, 723
Rossi, H.
2239-2241
Rossmann, T. G.
103
Rota, G.-C.
1309
Roth, B.
662
Rothberg, G. M.
489
Rott, N.
575, 576, 585
Rouffy, F. E., Jr.
2468
Roustan, A.
1577
Roy, S. N.
1858-1861, 1868, 1869
Rubel, L. A.
867, 868
Ruderman, M. A.
254
Rudin, W.
3002
Ruedl, E.
572, 573
Ruei, K. H.
2690, 2695
Ruffa, A. R.
411
Ruge, H.
523
Ruina, J. P.
922
Rumdqvist, S.
2794, 2796, 2800, 2803
Russell, G. A.
964
Rustgi, M. L.
3022
Rutenberg, Y. H.
404, 405
Rutgers U. Dept. of Physics, New Brunswick, N. J.
2445
Rutherford, J. L.
678, 679
Ryan, N. W.
2824
Rosendorff, S.
2878
Rosenfalck, P.
537
Rosengren, A.-M.
1122
Rosengren, E.
1122-1126, 1128, 1129
Rosengren, K.
1136, 1137
Sachs, H.
2976, 2977
Sachs, R. G.
514
Sack, R. A.
1236
Sacksteder, R.
1032
Sadjian, H.
3017
Sadler, R.
1973
Sadowski, W. L.
2686
Sager, W. F.
724
St. John, R. M.
1943, 1944, 1946, 1947
Sakita, B.
1189, 1191, 1194
Sakurai, A.
1817, 1818
Sakurai, T.
2127
Salam, A.
387
Salvi, G.
995, 1012
Samiullah, M.
2691
Sams, J. R., Jr.
2908, 2909
Sanan, S.
645
Sancier, K. M.
2499
Sand, D. M.
1696
Sandel, T. T.
1434, 1566
Sanders, B. L.
654
Sanders, P. H.
394
Sanders, T. M., Jr.
1726, 1727
Sankaranarayanan, R.
2148, 2150
Santibañez-H, G.
2105, 2113, 2115
Sarabhai, V. A.
1377
Sarhan, A. E.
1859
Sasaki, Y.
2428
Sassiver, M. L.
3035
Sato, S.
1895
Sattley, K.
2090
Satz, H. G.
1597
Sauer, R.
2732, 2735
Savage, L. J.
432

Savedoff, M. P.
2402
Savely, H. E.
42
Sawicki, J.
259, 261, 262, 266
Saxena, A. N.
2552, 2593
Saxon, D. S.
368
Scala, S. M.
718
Scanlon, J. H.
2450
Schaaf, S. A.
314, 315, 318
Schätz, R.
2738
Schalit, L. W.
1782
Schallenmuller, A. R.
1830
Schatzman, E.
218
Schiff, L. I.
2003, 2542, 2545
Schild, A.
2753
Schindler, W. F.
99-102
Schissler, L. R.
1348
Schlein, P. E.
1049
Schlenk, H.
1696
Schmidt, D. W.
1574
Schmidt, G.
2650, 2651, 2656
Schmidt, P.
3
Schmidt, V. H.
2913
Schmitt, R. H.
47, 48
Schnabel, W. F.
525
Schneider, J.
625, 635
Schoeffler, J. D.
1562
Schoenberg, I. J.
2073
Schoening, F. R. L.
684
Scholz, W.
1575
Schoonmaker, R. C.
491, 496
Schreurs, J. W. H.
501
Schultz, J. W.
1666
Schultz, R. D.
29
Schultz, S.
488
Schulz, L. G.
459
Schuske, G.
478
Schwartz, C.
2562
Schwartz, C. M.
92
Schwartz, M. D.
356, 357
Schwartzman, S.
2389
Schwarz, B.
2705, 2706
Schwinger, J.
770-772, 774, 780, 781, 786
Scodel, A.
1933, 1934
Scott, C. J.
1694
Scott, D. W.
193, 194
Scott, P. B.
1413, 1415
Scott, P. E.
1419
Scott, P. P.
1570
Scott, W. T.
1892
Scouler, W. J.
1353
Screaton, G. R.
378, 388
Sears, W. R.
588, 1758
Sedev, L. I., tr.
154
Seeds, R. B.
2644
Seegall, M. I. L.
156
Seegmüller, G.
2733, 2737
Seele, G. D.
1831
Segal, I. E.
437, 438, 1318
Segal, J. R.
2837
Segundo, J.
1151
Segundo, J. P.
951
Seibert, P.
2366, 2367
Seiden, P. E.
2597
Seidensticker, R. G.
2980
Seifert, R. L.
927
Sellen, J. M.
2765
Senitzky, B.
2701
Sensenig, C. B.
1800

Author Index

Serber, R.
483
Serrin, J.
1697, 1698
Setekleiv, J.
1960, 1963
Shalit, A. de
2559
Shanahan, J. P.
1029
Shannon, C. E.
1493
Shapiro, V. L.
2438-2441
Sharpton, F. A.
64
Shartle, C. L.
1937
Shaw, A. W.
2637
Shaw, M. E.
1772
Sheer, C.
2856
Sheline, R. K.
661, 666, 1366
Shelton, H.
2766
Sher, A.
2876
Sheridan, J.
128
Sherlin, G. C.
1755
Sherman, A.
710
Sherman, F. S.
310
Sherwin, C. W.
862, 865
Sherwood, T. K.
1297
Shibuya, I.
2063
Shideman, F. E.
2993
Shields, H.
631
Shiffman, C. A.
1754
Shisha, O.
759
Shmavonian, B. M.
623, 624
Shmoys, J.
2183, 2184
Shor, R. E.
1567
Shpiner, L.
856
Shrier, A.
2437
Shrikhande, S. S.
1857
Shuford, E. H.
1875-1877
Shugart, H. A.
269-272, 274
Shull, C. G.
1326
Shull, H.
931, 932
Shulman, I.
768
Shumaker, J. B.
1750
Shumway, R.
971
Sibbett, D. J.
27
Sichel, M.
2111, 2224
Siebert, W. H.
1321
Siegbahn, K.
2815-2817
Siegel, A.
134-136
Siegel, B. M.
568
Siegel, S.
12-15
Sienko, M. J.
559
Silber, L. M.
2176, 2177
Sillen, L. B.
2425
Silsbee, H. B.
2913, 2914
Silva, E. E.
950
Silver, M.
613
Silverman, A. J.
620-624
Silverman, E.
2275
Silverman, J.
1502, 1553
Silvidi, A. A.
1082-1086
Simanski, V.
2759
Simon, A. B.
1889, 1890
Simpson, J. A.
444-446, 448, 450-452
Simpson, W. T.
2899, 2903
Sinaike, H. W.
856
Sinclair, A.
766
Singer, I. M.
1295, 1296
Singer, J.
2711-2714
Singer, J. M.
412
Singer, J. R.
296-298
Singer, S. F.
1179-1181, 1221, 1223, 1224, 1226-1229
Skaug, O. E.
1963

Skell, P. S.
2016, 2017
Skewis, J. D.
2474
Skjeggestad, O.
458
Skoglund, C. R.
1073
Skolnik, S.
15, 16
Skrill, M. M.
1569
Skulan, T. W.
2993
Slade, J. J., Jr.
2437
Slawsky, M. M.
41
Slifkin, L.
1849
Smakula, A.
1352, 1353
Smeltzer, W. W.
399, 1142, 1143
Smetana, F. O.
2482, 2489
Smith, A.
2416
Smith, C. J.
2107, 2108
Smith, E. M.
1839
Smith, G. G.
2857-2861
Smith, G. M.
1290
Smith, J. W.
1306
Smith, M. J.
554
Smith, R. C.
2588
Smith, R. E.
648
Smith, R. L.
679, 2624, 2627
Smith, R. F.
332, 333
Smith, W. J.
2981
Smith, W. T., Jr.
1088, 1087
Smoldera, J. J.
2779
Smullin, L. D.
1461, 1500, 1530
Smyth, C. P.
2245, 2246
Sneddon, I. N.
614, 617, 618
Snow, C. A.
1193
Snow, G. A.
1196, 1201, 1208
Sobottka, S.
2579
Societe Francaise d'Etudes et de Realisations d'Inventions Coanda, Clichy (France).
2465
Socolowski, N. J
2760
Soderberg, U.
1077-1079
Sodickson, L.
1408
Softley, E. J.
179
Sogin, H. H.
175-178
Sogin, R. J.
176
Sohma, J.
1186
Sola Pool, I. de
767, 768
Solimene, N.
2703
Solomon, I. J.
842, 843
Solomonoff, R. J.
3047
Sommerfield, C. M.
778
Sommer-Smith, J. A.
952
Sorensen, T. S.
2986
Souquet, J.
1578
Spalding, D. B.
2768
Spangler, G. F.
678, 680
Sparks, R. A.
344, 345
Spearman, T. D.
383
Specht, M. R.
570
Speiser, R. C.
1832
Spence, D. A.
586, 587
Spence, R. D.
1598, 1599
Spencer, C. W.
554
Spencer, G. H., Jr.
2901, 2902
Sperduto, A.
666, 1366
Spitzer, R.
2296, 2297
Spokes, G. N.
1612
Sprecher, D. A.
1178
Springer, L. M.
2483
Srivastava, K. G.
1343
Stafford, S. L.
787, 790, 791

Author Index

Stager, C.
1481
Stager, C. V.
1539
Stanford Research Inst., Menlo Park, Calif.
2500
Stankevics, J. O. A.
1699, 1701
Stanley, J.
869, 880
Stapp, H. P.
260
Stear, E. B.
359, 364
Stehling, F. C.
2748
Steier, W. H.
903, 904
Steiger, M. H.
2144
Stein, E. M.
433, 1303
Steinberg, J.
2715, 2716
Stekly, Z. J. J.
82
Stenberg, E.
2802
Stepanov, V. V.
2228
Stephen, M. J.
502
Stern, D.
1225
Stern, E. A.
1219
Stern, K. H.
61, 62
Stern, R. A.
301, 309
Stevens, B.
2247
Stevens, K. N.
1451, 1522
Stewart, G. E.
2476
Stickel, C. A.
1607
Stiening, R.
1401
Stiles, R. M.
1612
Stokes, A. P.
2374
Stokes, C. S.
2741
Stone, F. G. A.
787-792
Stone, J. J.
2508
Strand, R.
1045
Strandberg, M. W. P.
1439, 1442, 1452, 1457, 1459, 1538, 1545, 1557
Strang, W. G.
1309
Strata, P.
2111
Strauss, H. L.
500
Street, R. E.
2898
Streever, R. L., Jr.
2443
Streitwieser, A., Jr.
236
Strodt, W.
509
Stroke, H. H.
1537, 1561
Stromblad, B. C. R.
1986
Strømme, K. O.
1955
Strutt, P. R.
685
Stubberud, A. E.
364
Studerus, C.
719
Sturrock, P. A.
2596, 2602, 2603, 2605, 2606, 2608
Subramanian, V. S.
176
Sucher, J.
1193, 1201, 1203, 1207, 1208
Sudarshan, E. C. G.
142, 143, 1402, 2412
Suhara, J.
1299
Sukhatme, S. P.
1319
Sullivan, J.
1878
Sullivan, R. D.
33, 34
Summerfield, M.
2207, 2209
Sunderland, R. J.
20-23
Sunner, S.
1137
Suss, J. T.
805
Sutherland, R. D.
704
Sutton, G. W.
716
Suzuki, S.
2470
Swanson, S. R.
2775
Swartz, G. A.
2312, 2313, 2316, 2318
Swarup, G.
2610, 2612, 2613, 2615, 2620
Sweetman, D. R
1376
Swenson, L. W.
1361
Swenson, W.
1407
Swets, J. A.
1464, 1509
Symons, M. C. R.
1703

Szebehely, V. G.
715
Szego, G.
2073

Tadjbakhsh, I. G.
1801
Taffara, L.
2783, 2784
Tajima, Y. A.
1779
Talbot, L.
310, 311, 719
Taleisnik, S.
2093, 2095-2101
Tallan, N. M.
50, 51
Talland, G. A.
1284
Tamura, I.
1898
Tanaka, Y.
653
Tang, T.-N.
911
Tang, Y. C.
655, 657, 659, 663
Tani, I.
593
Tani, S.
2306, 2879, 2882, 2888
Tanner, W. P., Jr.
1464, 1614, 1616
Tannhauser, D. S.
1349
Tanttila, W. H.
480
Taranto, J.
2396
Targonski, G. I.
1113
Tarifa, C. S.
962, 963
Tarski, J.
263, 265
Tate, R. F.
2511
Taube, M.
605
Tauber, G. E.
2966
Taupin, D.
2002
Tavenner, M. S.
2834, 2835
Taylor, G. A.
1982, 1983
Taylor, H. F. W.
4
Taylor, H. S.
697
Taylor, J. G.
377, 379, 380, 384, 385, 1209
Taylor, M. A.
371, 372
Taylor, R.
2860

Teare, J. D.
76
Tenney, S. M.
2417
Teorell, T.
2823
Terauds, A.
829-831
Terhune, R. W.
1641, 1642
Testa, C.
1661
Tewfik, O. K.
313, 319
Thaddeus, P.
485, 486, 498
Thesleff, S.
1117-1121
Thieberger, P.
1828
Thirring, W.
2841, 2842
Thirring, W. E.
2998
Thomas, E.
238, 239
Thomas, J. E., Jr.
2930-2932, 2934
Thomas, R.
1777
Thomas, R. E.
919
Thomson, C. G.
1572
Thomson, R.
875, 879
Thommen, H. U.
180
Thornthwalte, C. W.
607, 610
Thornthwalte, S.
607
Thornton, P. R.
376
Thorp, E.
1305, 1312
Thron, W. J.
477-479
Thrush, B. A.
1746
Thun, J. E.
2815
Thurston, M. O.
1918
Tickle, R. S.
2853
Tidwell, E. D.
1063
Tien, J. M.
672, 673
Tighe, N. J.
1749, 1750
Timm, D.
1137
Ting, L.
2152, 2155-2157, 2159, 2162
Ting, S.-F.
46

Author Index

Tinlot, J. H.
2412
Tint, S.
661, 682
Tippins, H. H.
895
Tisza, L.
1330
Toba, K.
2324, 2325, 2327, 2329
Toda, H.
430
Toll, J. S.
1199, 1206, 1209, 1210
Tomizuka, C. T.
459, 461, 462, 681
Tompkins, E. H.
841
Toong, T.-Y.
1322-1324
Topp, C. W.
404, 405
Torney, F. L., Jr.
1528
Torrey, H. C.
2442, 2444
Toth, R. S.
2915-2919
Towle, L. C.
2855
Townes, C. H.
483
Townsend, J.
2894
Träss, O.
1297
Trautman, A.
1846
Traving, G.
221
Treacy, E. B.
1822
Treanor, C. E.
549, 550
Treiman, S. B.
2255, 2265
Treischel, P. M.
789
Trella, M.
2145
Treves, F.
248, 249
Trivedi, J. P.
597, 598
Trivich, D.
2915-2919
Troy, B.
1275
Trubert, M.
671
Truce, W. E.
2292, 2293
Truell, R.
182
Truxal, J. G.
2186, 2189, 2190
Tsai, M.
2284
Tsai, Y.-S.
2546, 2558, 2564
Tsu, K.
2194, 2195, 2200
Tsukamoto, A.
133
Tsung, C. C.
925
Tu, Y.-O.
2347
Tubis, A.
2301
Tucker, R.
878
Tufts, D. W.
1499
Tung, T. K.
353
Turcotte, D. L.
582
Tuttle, T. R., Jr.
2527-2529, 2536
Tyrrell, V.
2430

Uehling, E. A.
1759
Unterleitner, F.
2069
Uppsala U. Gustaf Werner Inst. for Nuclear Chemistry (Sweden).
2792
Ur, H.
2188
Urabe, M.
2372
Uretsky, J. L.
2301, 2303
Urla, C.
2455
Ursin, H.
1970
Urtiew, P. A.
302, 305, 309
Utz, W. R.
1729, 1730

Vaglio-Laurin, R.
2142, 2145
Vaidhyanathan, V. S.
1065
Valley, L. M.
966-970
Van den Hende, J.
2054
Van der Laan, H.
2945, 2948
Van Nooijen, B.
2818
Van Ornum, G.
2129
Vand, V.
2027-2033, 2036-2038, 2047-2051, 2055, 2056, 2066, 2067
Vandenkerckhove, J. A.
690

van Driest, E. R. see Driest
Vanhuyse, V. J.
2569
Van Leeuwen, J. M. J.
2941
Van Patter, D. M.
675-677
Van Tiggelen, A.
1115, 1116
Van Valkenburg, M. E.
918, 922
Vanzulli, A.
952-955
Vardya, M. S.
251
Varney, R. N.
2873, 2874
Vaughan, W. E.
2246
Vaughn, M. T.
2299, 2302
Vavouras, G. T.
2019
Vedam, K.
2057, 2058, 2061
Vehling, E. A.
2911-2914
Veigele, W. J.
480
Veldman, D. J.
2755
Veleckis, E.
850
Venkates, H. G. R.
1452, 1457
Venkatraman, B.
2147, 2149
Venturi, G.
995, 1012
Venturini, E.
1893
Verbeek, L. A. M.
1514
Verber, C. M.
480
Verde, M.
2787
Verdier, R. F.
782
Verlet, L.
2005
Vincow, G.
503
Vinti, J. P.
1756, 1757, 1799
Viola, C.
2783, 2784
Vogt, M.
645
Vokes, J. C.
1995
Volk, H.
2907
Von Euler, U. S.
1074, 1075
Von Hippel, A.
1351
Von Wittern, W.
2730
Vøyenli, K.
1956
Vratny, F.
2284, 2285

Wada, J. Y.
2477
Waddell, W. R.
1290
Waddington, G.
1764
Wadsworth, H. M.
2973
Wahl, J. J.
2448
Waiter, S. A.
2481, 2483
Wakeman, D.
52
Waldeskog, B.
1132, 1134, 1135
Waldron, G. W. J.
130
Walecka, J. D.
2548, 2551, 2556, 2560
Wali, K. C.
514
Walia, J. S.
2472
Walker, C. T.
165
Walker, E. H.
1229
Walker, F. H.
1064
Wall, N. S.
1376, 1379
Wall, P. D.
1435, 1458
Wallenfels, K.
2987
Wallerstein, G.
224, 2401
Walsh, D.
1992, 1994-1997
Walsh, J. L.
759-761, 763, 765, 766
Walsh, P. N.
1912
Walsh, W. M., Jr.
748
Walter, F. J.
1760
Walter, W. G.
190-192
Walter, W. L.
1260
Wan, K.-S.
2158
Wang, P. E.
174
Wang, K.
2152, 2155, 2156
Wang, K. C.
2321

Author Index

Wang, S.
297
Wang, T. C.
484
Wang, W. S.-Y.
1636, 1638
Waniek, R. W.
2133
Warburton, A. E. A.
384
Ward, L. E., Jr.
1948-1950
Warren, R. P.
389, 390
Wartik, T.
2013, 2015
Washburn, J.
327
Wasilik, J. H.
1751-1753
Watson, K. M.
276-278
Watson, M. D.
2963
Watson, R. E.
1327-1329, 1409-1411
Watt, L. A. K.
1676
Waugh, J. S.
1347, 1438, 1547
Wayman, C. M.
876
Webb, M. B.
713
Webb, R. H.
2537
Webber, C. E.
898
Wecker, M. S.
2218
Weckman, N.
1080
Weger, M.
806
Weight, F.
2225
Weil, R.
2455, 2461
Weinberg, A. M.
2259
Weinberger, H. F.
1245, 1246, 1248, 1249
Weiner, M. A.
1552
Weiner, R. S.
2338
Weinig, S.
1569
Weinrich, G.
3034
Weinstein, A.
1252
Weinstein, H.
2976
Weinstein, R.
1357
Weir, D. S.
2399
Weiskrantz, L.
391, 392
Weiss, A.
472
Weiss, G.
2936
Weiss, G. H.
1212, 1236, 1244, 1242
Weiss, R.
1556
Weissinger, J.
2729
Weissman, S. I.
2893-2896
Weissmann, S.
2437
Wendlandt, W. W.
2747
Wentworth, R. C.
1221, 1222
Werner, W.
2734
Wert, C.
870, 880
Wertz, J. E.
1702, 1705-1707, 1714, 1716
Weske, J. R.
1261
Wess, J.
2843
Wessel-Berg, T.
2604
West, C.
869
West, R.
2989-2992
Weymann, H. D.
1262, 1265, 1271, 1272, 1275
Weymann, R.
226
Whatley, L. S.
2989
Wheeler, J. A.
2262
Wheeler, R. G.
3028
White, D.
1911, 1912
White, H.
426
White, J. A.
3027
White, R. E.
1368, 1375
Whitehead, W. D.
2853
Whitehouse, D. R.
1488
Whitman, G. B.
1314
Whitmore, D. H.
1900
Whyburn, G. T.
2845, 2846, 2848, 2850
Wiberg, K. B.
2901, 2902
Wiberley, S. E.
2340

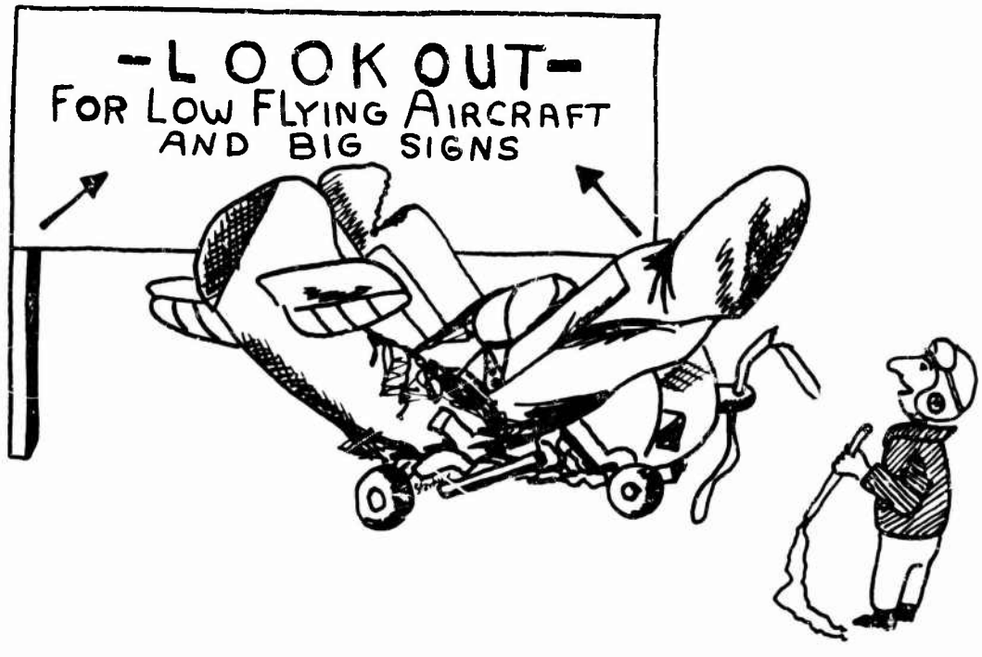
Widder, D. V.
764
Widom, B.
558
Widrow, B.
2635, 2642, 2649
Wiech, R. E.
2762, 2764
Wiedling, T.
2577
Wielen, R.
701
Wiesel, T. N.
793
Wight, H. M.
40
Wightman, A. S.
2260
Wigner, E. P.
2259, 2263, 2264
Wilby, P. G.
36, 38
Wilcox, C.
1027
Wilcox, L. R.
744
Wild, R. L.
891
Wilde, A. F.
927
Wilder, R. L.
1617, 1620
Wildermuth, K.
655, 657, 661-664
Wilkerson, T. D.
1621-1623
Willardson, R. K.
90
Willens, R. H.
216
William, D.
1921-1925, 1927, 1928
Williams, M. J.
552
Williams, T.
1058, 1061
Williamson, H. E.
2993
Willis, D. R.
2219, 2223, 2432-2436
Willmarth, W. W.
1604
Wilsdorf, H. G. F.
685
Wilson, W. B.
92
Wimmel, H. K.
3010, 3011, 3017
Wing, J.
281, 285
Wise, H.
2499
Wishner, R. P.
858
Witteman, W. J.
1268, 1269
Witten, L.
2391
Wittiff, C. E.
544
Wojtaszek, J. H.
1364
Wolf, E.
2408-2410
Wolfhard, H. G.
2759
Wolfowitz, J.
566
Wolfson, R.
1785
Wolfson, R. G.
1902
Wondratschek, H.
2065
Woodward, D. A.
1671
Worchel, P.
1774, 2755, 2756, 2758
Worth, D. C.
2852
Wozencraft, J. M.
1507
Wright, E. W., Jr.
1732, 1733, 1735
Wu, A. C.-T.
1198
Wu, C.-S.
2213, 2222
Wu, F. Y.
2886
Wu, G.-S.
2985, 2986
Wu, T. T.
749-752
Wu, T.-Y.
2966
Wuerker, R. F.
2766
Wunderlich, J. A.
754, 756, 1710
Wurster, W. H.
550, 551
Wylie, K. F.
1082

Xavier, J.
864
Xhignesse, L. V.
899

Yabroff, I. W.
2622, 2624
Yamanouchi, T.
2403, 2404
Yanai, H. S.
1711
Yang, H.-T.
1231, 2484, 2485
Yang, K. S.
2612, 2613
Yeh, G. S.-Y.
569
Yeh, J.
1673

Author Index

Yen, K. T.
2325, 2326, 2328-2332
Yim B.
169, 170
Yin, M.
2566, 2567
Yngve, V. H.
1445, 1476
Yood, B.
3004
Yoshimine, M.
472
Yoshizawa, T.
2371, 2377
Youla, D. C.
2187
Young, A. P.
92, 93
Young, J. R.
914
Young, J. Z.
1105
Young, K. P.
2171
Young, R. A.
737
Young, R. D.
2025, 2026
Yu, E.-Y.
2568
Yu, J.
2431
Yu, Y.-Y.
2165-2167
Zacharias, A.
1461
Zachariasen, F.
2540, 2541, 2547, 2557
Zafra, R. L., de
2087
Zames, G.
1506
Zandstra, P. J.
2536
Zauli, C.
1107, 1108
Zeleny, W. B.
2692
Zeller, E.
555
Zernik, W.
3022
Zimmer, H.
727, 728
Zimmerman, W. B.
1600, 1601
Ziock, K.
3022
Zisfein, M. B.
104, 106, 107
Zuidema, G. D.
1290
Zumwalt, G. W.
924
Zwick, S. A.
24
Zygmund, A.
433-435



Subject Index

Ablation
see as a subdivision, e.g. Iron - Ablation
Absorption spectra - Analysis
926
Absorption spectra - Intensity
1536
Absorption spectra - Mathematical analysis
2414
Absorption spectra - Pressure effects
2751, 2752
Absorption spectra - Temperature effects
2752
Accelerators
see also specific types of accelerators, e.g., Particle accelerators
Accelerators - Design
82
Acetaldehyde - Spectra
2398
Acetates - Metabolism
1980
Acetates - Synthesis
864
Acetone - Free radicals
2895
Acetonitrile - Solvent action
1713
Acetylcholine - Contractural properties
1118, 1119
Acetylene compounds - Hydrogen bonds
2992
Acetylene compounds - Synthesis
848
Acetylglycine - Electron spin resonance
633
Acetylglycine - Free radical structure
633
Acids - Chemical reactions
1717, 1721, 1723, 1724
Acoustic properties - Test methods
156
Acoustic properties - Theory
158
Acoustic stimuli - Propagation
1520
Acoustic streams - Generators
156-159
Acoustic streams - Heat transfer
161
Acoustic streams - Photographic analysis
159
Acoustic systems - Instrumentation
1432
Acoustic vibrations - Convective flow
736
Acoustic vibrations - Smoke patterns
736
Acoustics - Mathematical analysis
1518, 2771
Acoustics - Test methods
1520, 1521
Acoustics - Theory
1486, 2770, 2776
Acoustics (Nonlinear) - Applications
160, 161
Acoustics (Nonlinear) - Theory
156-159
ACTH
see Adrenocorticotropic hormone
Activation energy - Bismuth selenide crystals
855
Activation energy - Silver iodide crystals
855
Activation energy - Zinc oxide crystals
855
Active Networks and Feedback Systems - Symposium
2179
Acylpyridinium salts - Chemical reactions
848
Adhesion - Measurement
2336, 2339
Adenohypophysis - Hormonal control
2100
Adrenal glands - Secretion
1127
Adrenalectomy - Renal properties
2993
Adrenaline
see Epinephrine
Adrenocorticotropic hormone - Purification
794
Adrenocorticotropic hormone - Secretion
794
Adsorption - Thermodynamic properties
2193
Aerodynamic configurations - Flow fields
2145
Aerodynamic configurations - Fluid flow
2420
Aerodynamic configurations - Gas flow
317, 2142
Aerodynamic configurations - Transonic flow
180
Aerodynamic data - Tables
2710
Aerodynamic heating - Analysis
1412, 2740
Aerodynamic heating - Countermeasures
1412, 1692, 1693, 1699, 1700
Aerodynamic heating - Mathematical analysis
584, 2156
Aerodynamic heating - Theory
579, 2522
Aerodynamic noise - Theory
2770, 2776
Aerodynamics - Mathematical analysis
2159, 2422, 2729
Aerodynamics - Physical chemistry
2071
Aerodynamics - Separation flow
318
Aerodynamics - Theory
179-181, 578, 580, 581, 2898
Aerodynamics - Viscosity
578
Afferent impulses - Central regulation
2118

Subject Index

Afterbodies - Pressure distributions
925
Aging - Cell morphology
1494
Aging - Perception accuracy
1284
Air - Free radical analysis
2516
Air - Thermal diffusion
718
Air defense - Antiaircraft systems
856
Air flow - Pressure
1333
Airbreathing Combustion - Symposium
303
Aircraft - Aerodynamic characteristics
106
Aircraft - Control systems
859
Aircraft - Detection
2129
Aircraft - Flutter
106
Aircraft components
see specific components, e.g., Wings
Aircraft detection - Upper atmosphere
2129
Airfoils - Aerodynamic characteristics
315, 584
Airfoils - Boundary layer
1341, 2729
Airfoils - Magnetohydrodynamic flow
583
Airfoils - Oscillation
583
Airfoils - Pressure distribution
2710
Airfoils - Supersonic characteristics
2710
Airfoils - Surface temperature
584
Airfoils - Transonic characteristics
180, 1341
Airfoils (Ring) - Aerodynamic characteristics
2729
Airfoils (Ring) - Mathematical analysis
2729
Airplane panels - Flutter
200
Airplane panels - Supersonic flow
200
Alcohols - Chemical reactions
1088, 2290, 3035, 3036
Aldehydes - Spectra
1187
Alfven mach number - Mathematical analysis
74
Algebra
see separate Mathematical Subject Classification, p. 903
Aliphatic compounds
see also specific compounds, e.g., Butane
Aliphatic compounds - Chemical reactions
1651
Alkali-gas systems - Molecular beams
496
Alkali halide complexes - Dissociation
495
Alkali halide complexes - Nuclear magnetic moment
493, 495
Alkali halide crystals
see also specific alkali halide crystals, e.g., Sodium iodide crystals
Alkali halide crystals - Binding energy
489
Alkali halide crystals - Color centers
887, 989, 990
Alkali halide crystals - Ductility
326
Alkali halide crystals - Electron transitions
303
Alkali halide crystals - Hall effect
892, 893
Alkali halide crystals - Luminescence
989, 990
Alkali halide crystals - Mathematical analysis
323
Alkali halide crystals - Photochemistry
888, 891, 2393
Alkali halide crystals - Preparation
322
Alkali halide crystals - Radiation effects
987
Alkali halide crystals - Resonance absorption
886
Alkali halide crystals - Scattering
892
Alkali-halide gas systems - Molecular beams
496
Alkali halides - Binding energy
489, 2495, 2496
Alkali halides - Color centers
49
Alkali halides - Configuration models
839
Alkali halides - Dielectric properties
989, 990
Alkali halides - Diffusion
49
Alkali halides - Electrical properties
49, 726, 1348
Alkali halides - Isobaric experiments
839
Alkali halides - Luminescence
839, 840, 987
Alkali halides - Physical properties
1348
Alkali halides - Polymerization
2494, 2496
Alkali halides - Salt complexes
493
Alkali halides - Spectra
882, 1613, 2494
Alkali metal compounds - Free radicals
2895

Alkali metal compounds - Vaporization
494
Alkali metal halide crystals
see Alkali halide crystals
Alkali metal halides
see Alkali halides
Alkali metal vapors - Free electrons
635
Alkali metal vapors - Ionization
22
Alkali metal vapors - Microwave spectrum
635
Alkali metal vapors - Thermodynamics
494
Alkali metals - Flames
635
Alkali metals - Ionization
22
Alkali metals - Plasma propulsion
84
Alkali metals - Specific heat
329
Alkaline earth fluorides - Density
2741
Alkaline earth halides - Energy
2495
Alkalis - Hyperfine structure
3014
Alkaloids - Molecular structure
1711, 1712
Alkoxysilanes - Basicities
2989
Alkyl bromides - Relaxation time
2245
Alkyl groups - Chemical reactions
2472
Alkyl halides - Chemical bonds
499
Alkyl halides - Chemical reactions
2291
Alkyl halides - Nuclear quadrupole coupling
499
Alkyl radicals
see also specific alkyl radicals, eg., Butyl radicals
Alkyl radicals - Electro-negativity
506
Alkyl radicals - Nuclear magnetic resonance
505
Alkynes
see specific acetylenic compounds, e.g., Acetylene
Alloys
see also specific alloys, e.g., Aluminum - iron alloys
Alloys - Angle scattering
1904
Alloys - Crystal structure
372, 374, 375
Alloys - Deformation
872
Alloys - Diffusion
869, 870, 872, 880
Alloys - Electron micrographic analysis
684
Alloys - Electron transitions
1932
Alloys - Fracture (mechanics)
525
Alloys - Heat content
328, 330
Alloys - Magnetic properties
979, 986
Alloys - Mechanical properties
1901
Alloys - Molecular distribution
1903
Alloys - Oxidation-reduction reactions
399, 2251
Alloys - Phase studies
371, 373, 870
Alloys - Precipitation
684
Alloys - Specific heat
329
Alloys - X-ray analysis
371-373
Allyl alcohols - Chemical reactions
3035
Allyl compounds - Spectra
1552
Alpha particles - Energy spectra
2405, 2884
Alpha particles - Mean free path
2885
Alumina
see also Sapphires
Alumina - Crystal structure
50, 51
Alumina - Dielectric properties
50, 51
Alumino-silicate glass - Applications
2632
Aluminum - Electrolytic polishing
1904
Aluminum - Impact shock
1035, 1036
Aluminum - Nuclear magnetic resonance
480
Aluminum - Shock waves
2498, 2503, 2504
Aluminum - Thermal properties
2498, 2503
Aluminum alloys - Creep
2526
Aluminum alloys - Fatigue tests
2775
Aluminum alloys - Stresses
2526, 2775
Aluminum bromide - Conductivity
2013
Aluminum bromide - Solubility
2013
Aluminum chloride - Conductivity
2013
Aluminum chloride - Mass spectra
555
Aluminum chloride - Solubility
2013

Subject Index

Aluminum compounds - Crystal structure
2429
Aluminum compounds - Stereochemistry
400, 401
Aluminum-copper-iron alloys - Crystal structure
374
Aluminum crystals - Deformation
2079
Aluminum crystals - Preparation
2079
Aluminum electrodes - Electrochemistry
1655
Aluminum fluorides - Dissociation energies
555
Aluminum fluorides - Mass spectra
555
Aluminum foils - Applications
2852
Aluminum halides - Mass spectra
555, 557
Aluminum halides - Solubility
2013
Aluminum-iron alloys - Internal friction
981
Aluminum-iron alloys - Magnetic properties
981
Aluminum isotopes - Alpha bombardment
1368
Aluminum isotopes - Polarization
1599
Aluminum isotopes - Relaxation time
1599
Aluminum-magnesium alloys - Fatigue
130
Aluminum-manganese alloys - Crystal structure
372
Aluminum-manganese alloys - Phase studies
371
Aluminum-manganese alloys - X-ray analysis
371, 372
Aluminum oxides
see Alumina; Corundum; Sapphires
Aluminum phthalocyanines - Stereochemistry
400, 401
Aluminum silicates - Paramagnetic resonance
807
Aluminum-silver alloys - Deformations
1895
Aluminum-silver alloys - Mathematical analysis
1903
Aluminum triethyl - Pyrolysis
1778
Aluminum triethyl - Thermochemistry
1778
Aluminum-zinc alloys - Shear stresses
1901
Anine oxidase - Inhibition
1986
Amine-water reactions - Nuclear magnetic resonance
652
Amine-water reactions - Proton transfer
653
Amines - Biochemical reactions
1074-1076
Amines - Biosynthesis
1987
Amines - Chemical reactions
1087, 1125, 1568, 1989
Amines - Molecular structure
1088
Amines - Oxidation-reduction reactions
1568, 1987
Amines - Photometry
1064
Amines - Storage
1122, 1123, 1126
Amines - Synthesis
1568
Amino acids - Decarboxylation
1985
Amino acids - Electron spin resonance
631, 632
Amino acids - Free radical structure
631, 632
Ammines - Substitution reactions
1651
Ammonia - Decomposition
204, 210
Ammonia - Propellant properties
2134
Ammonia - Spectra
1057, 1059, 1062, 1063
Ammonia - Substitution reactions
1651
Ammonia-argon mixtures - Enthalpy
204, 210
Ammonium carbamate - Hydrolysis
1942
Ammonium chloride - Decomposition
28
Ammonium ozonide - Properties
842, 843
Ammonium ozonide - Synthesis
843
Ammonium perchlorate - Burning rate
68, 73
Ammonium perchlorate - Combustion
27, 73, 1104, 2209
Ammonium perchlorate - Decomposition
32
Ammonium radicals - Proton transfer
650, 651
Ammonium salts - Reaction kinetics
651
Amphetamine - Amine oxidase
1986
Amphetamine - Oxidation-reduction reactions
1986
Amplifiers
see also specific types of amplifiers, e.g., Microwave amplifiers
Amplifiers - Circuits
1517
Amplifiers - Design
1439, 1826, 2640, 2647
Amplifiers - Mathematical analysis
483, 1439, 2640, 2647

Amplifiers - Stabilization
2640
Analog computers
see also Mathematical computers
Analog computers - Applications
1787
Analog computers - Control systems
2648
Analog computers - Design
2636
Analytic functions - Mathematical analysis
2191
Anemometers - Design
181
Anemometers - Mathematical analysis
1034
Anemometers - Performance
1033, 1034
Anesthetics - Physiological effects
1288
Anhydrides
see Phthalic anhydride
Aniline - Dielectric relaxation
625
Anion interference - Mathematical analysis
564
Anisotropy - Determination
885
Annihilation reactions - Analysis
1589
Annihilation reactions - Mesons
2008
Annihilation reactions - Thermodynamics
2811
Anodes - Design
2856
Anoxia
see Hypoxia
Antenna radiation patterns - Analysis
1491, 2610
Antenna radiation patterns - Mathematical analysis
1990, 2611, 2618
Antennas
see also specific types of antennas, e.g., Parabolic antennas
Antennas - Applications
2614
Antennas - Design
2620
Antennas - Electrical properties
1990
Antennas - Phase studies
2613
Antennas - Theory
749, 2611, 2618
Anthracene - Molecular structure
1144, 1146, 1907
Anthracene - Spectra
2963
Anthracene-trinitrobenzene complex - Emission spectrum
649
Anthracene-trinitrobenzene complex - Luminescence
649
Antialrcraft defense - System analysis
856
Antiferromagnetic crystals - Exchange patterns
2125
Antiferromagnetism - Mathematical analysis
1545
Antiferromagnetism - Theory
1930, 1931
Antimony - Flow stability
1576
Antimony compounds - Crystal structure
2808
Antimony compounds - Physical properties
2807
Antiprotons - Nuclear reactions
2008
Antiprotons - Scattering
1589
Applied Masses - Symposium
1141
Argon - Applications
3033
Argon - Atomic beams
1556
Argon - Electron diffusion
1262
Argon - Electrostatic properties
1262
Argon - Gas flow
2482
Argon - Gyromagnetic properties
3034
Argon - Ionization
1680, 2855
Argon - Magnetic moments
3026
Argon - Shock waves
1265, 1266, 1271, 1275
Argon (Liquid) - Solvent action
2907
Aromatic compounds
see also specific aromatic compounds, e.g., Benzene
Aromatic compounds - Photometry
1064
Aromatic compounds - Spectra
2751, 2752, 2963
Arsenic isotopes (Radioactive) - Decay
2821
Arsenic isotopes (Radioactive) - Spectra
2821
Aryl carbonates - Pyrolysis
2859
Ascorbic acid - Hormonal influence
2095
Astrodynamics - Bibliography
339
Astrodynamics - Dictionary
338
Astrodynamics - Mathematical analysis
341, 342
Astrodynamics - Theory
340, 343

Subject Index

Astronautics - Research
335, 336
Astronautics - Symposium
43
Astronautics - Theory
1756, 1757
Astrophysics - Quantum mechanics
154
Astrophysics - Radiation survey
2402
Atmosphere
see also Upper atmosphere
Atmosphere - Electron density
2271
Atmosphere - Gaseous effects
2451
Atmosphere - Hydrogen profiles
2400
Atmosphere - Ionization
2479
Atmosphere - Molecular flow
2219, 2223
Atmosphere - Radiation
1135, 1377, 1384, 1825, 2402, 2455, 2456
Atmosphere - Spectrographic data
2401
Atmospheric pollutants - Electron paramagnetic resonance
2516
Atmospheric sounding - Equipment
2271, 2272
Atomic beam resonance - Measurement
3026
Atomic beam resonance - Theory
3026, 3027
Atomic beams - Applications
706, 708, 709
Atomic beams - Measurement
488, 490
Atomic charges - Determination
1543
Atomic energy levels - Electron transitions
2448-2450, 3027
Atomic energy levels - Mathematical analysis
929
Atomic mass - Determination
1138, 1139, 1141
Atomic orbitals
see also Wave mechanics
Atomic orbitals - Correlation energy
930
Atomic orbitals - Mathematical analysis
882, 1107
Atomic properties - Optimal shift analysis
2066
Atomic scattering factors - Computer programming
2055
Atomic spectra - Analysis
2551, 2556
Atomic structure - Ion microscopy
2022
Atomic structure - Iron series
1328
Atomic structure - Mathematical analysis
1328, 2125
Atomization - Properties
2204, 2205
Atoms - Auger effect
1045
Atoms - Correlation energy
931
Atoms - Electron transitions
2550
Atoms - Ion microscopy
2023
Atoms - Kinetic theory
1945
Atoms - Optimal shift
2066
Atoms - Photoelectric effect
449
Atoms - Recombination reactions
2000
Atoms - Solvent effects
964
Atoms - Spectrographic analysis
2910, 3010, 3012
Attention - Electroencephalography
97, 1961
Attention (Cat) - Cortical stimulation
1970
Attention (Psychology) - Cortical stimulation
1962
Attitudes - Classification
976
Auditory nerve - Responses
1450
Auditory nerve - Stimuli analysis
1469
Auditory nervous system
see Nervous system (Auditory)
Auditory perception - Age factors
1284
Auditory perception - Psychophysiological factors
131, 821
Auditory perception - Stimulation
1633, 1634
Auditory perception - Test methods
441, 821, 1284
Auditory perception - Theory
169
Auditory perception (Cat) - Electrical factors
442
Auditory responses - Mathematical analysis
1449
Auditory signals - Detection
1469
Aviation accidents - Electroencephalographic correlations
537
Axial flow compressors - Performance
212
Azides - Decomposition
2952
Azides - Ultraviolet radiation
2952
Azoisobutane - Decomposition
69

Azoles - Chemical reactions
599
Azoles - Synthesis
598, 599

Backward wave amplifiers - Noise
295
Bacteria
see Microorganisms
Balances (Instrumentation) - Design
2747
Band-pass amplifiers - Transient characteristics
2178
Band spectra - Determination
2010
Barium bromate monohydrate - Magnetic resonance
1084
Barium bromide monohydrate - Magnetic resonance
1083
Barium isotopes - Angular correlations
2819
Barium isotopes - Nuclear spins
2819
Barium isotopes (Radioactive) - Decay
1595
Barium oxides - Spectra
2950
Beams - Deformation
1332
Beams - Mathematical analysis
538
Beams - Stresses
2146, 2149, 2521
Beams (Electromagnetic) - Diffraction analysis
2410
Beams (Structural) - Vibration
2343, 2345, 2347
Bearings
see also specific types of bearings, e.g., Gas bearings; Journal bearings
Bearings - Lubrication
216
Bearings - Theory
687, 688
Behavior - Drug effects
1962, 2102
Behavior - Facet theory
975-977
Behavior - Psychological analysis
1472, 1795, 1796, 1933, 1934, 1936, 1937, 2243, 2755, 2756
Behavior - Test methods
188, 952, 1933, 1934, 1936, 1937, 2418
Behavior (Cat) - Drug effects
1961, 1963, 1970, 2464
Behavior (Cat) - Sensory perception
952
Behavior (Monkey) - Auditory perception
392
Behavior (Monkey) - Cortical stimulation
392
Behavior (Monkey) - Sensory perception
391, 392
Behavior (Monkey) - Time perception
391
Behavior (Physiology) - Analysis
2111, 2464
Behavior (Psychology) - Birds
389, 390, 2111
Behavior (Psychology) - Data processing systems
728
Behavior (Psychology) - Decision making
1624
Behavior (Psychology) - Homeostasis
2243
Behavior (Psychology) - Hostility
2758
Behavior (Psychology) - Interracial groups
2757
Behavior (Psychology) - Monkeys
391, 392
Behavior (Psychology) - Sociological analysis
738, 2697
Behavior (Psychology) - Statistical analysis
1877
Behavior (Sociology) - Analysis
975-977
Behavior patterns (Pigeons) - Physiological analysis
2789
Behavior science (Opossum) - Sleep
127
Benzene - Addition reactions
1955
Benzene - Ionization potential
653
Benzene - Photochemistry
1613
Benzene - Spectra
2963
Benzene derivatives - Ionization potentials
653
Benzene derivatives - Photolysis
1612
Benzene derivatives - Physical properties
1065, 2899
Benzeneboronic acid - Chemical reactions
1766-1768
Benzonitrile - Infrared spectra
532
Benzophenone - Dielectric relaxation
625
Benzosemiquinones - Hyperfine structure
501
Benzyl carbonates - Pyrolysis
2959
Benzyl compounds - Molecular structure
1951
Benzyl halides - Chemical reactions
2291
Benzyne - Detection
1612, 1613
Berthollide compounds - Diffusion
1609
Berthollide compounds - Sintering
1609
Beryllium - Atomic orbitals
408

Subject Index

Beryllium - Crystal structure
408
Beryllium lsotopes - Angular distribution
1365
Beryllium lsotopes - Atomlc energy levels
657
Beryllium silicates - Paramagnetic resonance
807
Beta decay - Energy
1141
Beta decay - Mathematical analysis
2004
Beta decay - Theory
1140
Beta particles - Polarization
3023
Betatrons - Energy control
2083
Blbliography - Astrodynamlcs
339
Blbliography - Combustion
72
Bibliography - Deterrence strategies
1906
Bibliography - Detonation waves
301
Blbliography - Electron spln resonance
634
Bibliography - Lasers
2703
Blbliography - Lumlnescence
94, 95
Blbliography - Microwave spectroscopy
634
Blbliography - Operations research
2786
Blbliography - Preclpitatlon chemistry
608
Blbliography - Semlconductors
94, 95
Blbliography - Small group research
829, 831
Blbliography - Systems research
2786
Bicyclic compounds
see Cyclic compounds
Bloelectronic slgnals - Recording devlces
727, 956
Blological mechanlsms - Air ion effects
331, 332
Blological systems - Analysls
1037
Blological systems - Reliability
1433
Blophyslcs - Mathematical analysis
426
Biosynthesis - Study methods
2977
Biradicals - Electron spin
2893
Birds - Reproductive system
389, 390
Bisdiphenylenephenylallyl - Specific heat
2534
Bismuth - Cyclotron resonance
279
Blsmuth - Electron scattering
2574
Blsmuth-selenium alloys - Electrlcal properties
554
Bismuth trloxide - Preparation
1089
Bismuth trioxide - Semiconducting properties
1089
Bismuth trlsulfide - Preparatlon
1089
Bismuth trlsulfide - Semlconducting properties
1089
Blood - Chromatographlc analysis
276
Blood clrculation - Physlological changes
2788, 2791, 2792
Blood plasma - Drug effects
1963
Blood pressure - Measurement
2417
Blood vessels - Constrlction
1080
Blood vessels - Innervation
1080
Blunt bodies - Boundary layer
1413, 2153
Blunt bodies - Cooling
1699, 1700
Blund bodies - Flow fields
2145
Blunt bodies - Heat transfer
579, 2213
Blunt bodies - Hypersonic characteristics
542, 543, 1336, 2153, 2222, 2320
Blunt bodies - Perturbation theory
2142
Blunt bodies - Supersonlc characterlstics
2142
Bodies of revolutlon - Hydrodynamic characterlstics
2161
Bodies of revolutlon - Mathematical analysis
2264
Bodies of revolution - Oscillation
2736
Bodies of revolution - Stagnation point
1604
Bodies of revolution - Transonic characteristics
179
Bone - Mineral distrlbution
1066
Bone - Porphyrin distrlbution
1069
Bone - Radiation effects
1068
Bone - Structure
1068
Bone crystallites - Properties
1070
Bone structure - X-ray diffraction analysis
1070
Borides - Crystal structure
2795, 2797-2799

Borides - Properties
2795
Boron - Radiation effects
182
Borohydrides - Reaction kinetics
474
Boron compounds - Decomposition
2014, 2015
Boron compounds - Hydrogenation
2014
Boron compounds - Purification
1918
Boron compounds - Thermodynamics
2015
Boron compounds (Organic) - Chemical reactions
2906
Boron compounds (Organic) - Synthesis
790, 2906
Boron fluoride - Impurities
1824
Boron hydrides - Crystal structure
756
Boron hydrides - Resonance
1024
Boron hydrides - Spectrographic analysis
1024
Boron-iodine compounds - Resonance
1024
Boron-iodine compounds - Spectrographic analysis
1024
Bosons - Ground state
2886
Bosons - Nuclear reactions
2692
Bosons - Quantum mechanics
138, 139, 141, 2692
Bosons - Scattering
2887
Botulinum - Inhibitive properties
1120
Boundary layer
see also Laminar boundary layer
Boundary layer - Axisymmetric flow
2328, 2329
Boundary layer - Composition
1412
Boundary layer - Compressible flow
2221
Boundary layer - Flow fields
1534
Boundary layer - Heat transfer
1297, 1412, 1417, 2319
Boundary layer - Hypersonic flow
2222
Boundary layer - Mathematical analysis
586, 1737, 1740, 2217, 2326, 2329, 2331, 2332, 2568
Boundary layer - Perturbation
2782
Boundary layer - Phase transitions
1276-1279, 1829
Boundary layer - Stability
2780
Boundary layer - Surface properties
1403
Boundary layer - Theory
213, 214, 1805
Boundary layer - Turbulence
1604, 2210
Boundary layer - Viscous flow
2222
Boundary layer control - Drag
528, 529
Boundary layer control - Fluid injection
1413, 1419
Boundary layer control - Heat transfer
2481
Boundary layer control - Instrumentation
528
Brain - Amines
1127
Brain - Biological rhythms
1283
Brain - Cortical activity
1492, 1531
Brain - Electroencephalography
96, 189, 1280, 1286, 2104
Brain - Electrode implantation
951
Brain - Electrical properties
189, 1171, 1280, 1283, 1531, 1732, 1735, 2463
Brain - Functional analysis
1743, 1744, 1971, 2531
Brain - Morphology
1743
Brain - Physiology
1745
Brain - Psychological factors
1171
Brain - Radiation effects
2792
Brain - Stimulation
1285, 1971
Brain - Test equipment
1731, 1733, 1734
Brain (Beaver) - Comparative anatomy
108-112, 114-120, 122-125
Brain (Beaver) - Ontogeny
120
Brain (Beaver) - Physiology
108-112, 114-120, 122-125
Brain (Cat) - Cortical activity
1560
Brain (Cat) - Electrical properties
1527, 2103
Brain (Cat) - Nerve cells
1527
Brain (Cat) - Physiology
2118, 2119
Brain (Cat) - Stimulation
1150, 1153, 1155, 1157-1160, 1162-1165, 1165-A, 1166-1169, 1527, 1566, 1658, 1961, 1963, 1970, 2112, 2119, 2463
Brain (Cat) - Surgery
2107, 2108, 2118
Brain (Goat) - Radiation effects
2793

Subject Index

Brain (Monkey) - Cortical responses
2418
Brain (Monkey) - Electrical properties
2418
Brain (Monkey) - Stimulation
1154, 2418
Brain (Pigeon) - Radiation effects
2790
Brain (Rabbit) - Cortical responses
1964
Brain (Rabbit) - Drug effects
645, 1960
Brain (Rabbit) - Electrical properties
1967-1969
Brain (Rabbit) - Stimulation
1079, 1964, 1967-1969
Brain (Rabbit) - Surgery
1079
Brain (Rat) - Radiation effects
2788, 2791
Brain (Rat) - Sex control
1966
Brain (Rat) - Surgery
2092
Brain (Rodent) - Comparative anatomy
108, 111-126
Brain (Rodent) - Physiology
111-126
Brain (Rodent) - Taxonomy
121
Brain mechanisms - Theory
1152, 1433, 1472, 2103, 2119
Brain metabolism - Neuraminic acid effects
2531
Brain tissue - Protamine effects
1572
Brain tissue (Hamster) - Hypoxia effects
1575
Brass crystals - Deformation
376, 685
Brass crystals - Dislocations
685
Brass crystals - Stresses
376
Brass film - Preparation
600
Brazil - Group dynamics
520
Bremsstrahlung - Cross sections
2561
Bremsstrahlung - Intensity
2580
Bremsstrahlung - Mathematical analysis
2036
Bremsstrahlung - Measurement
2593, 2815
Bremsstrahlung - Spectrographic analysis
2550
Bromides - Chlorination
2017
Bromine - Additional reaction
1955
Bromine isotopes (Radioactive) - Decay
677, 1374
Bromine isotopes (Radioactive) - Nuclear energy levels
677
Bubble chambers - Applications
1390
Bubble chambers - Operation
1380
Bubble chambers - Photography
2699
Buckling - Mathematical analysis
2711-2713
Buckling - Theory
2521
Butadiene - Chemical reactions
133
Butane - Decomposition
69, 2749
Butane - Reaction kinetics
2749
Butane - Synthesis
2016
Butyl radicals - Chemical reactions
1081
Butyl radicals - Rearrangement
2017
Butylacetic acid - Synthesis
1913
Butylketene - Synthesis
1915
Butylperoxyformate - Synthesis
198

Cadmium - Flow stability
1576
Cadmium - Physical properties
569, 1502
Cadmium - Vapor deposition
569
Cadmium crystals - Growth
569
Cadmium isotopes - Hyperfine structure
492, 498
Cadmium isotopes - Resonance fluorescence
498
Cadmium isotopes (Radioactive) - Optical analysis
896
Cadmium sulfide crystals - Electron density
852
Cadmium sulfide crystals -Resonance absorption
1644
Cadmium sulfide crystals - X-ray diffraction analysis
852
Cadmium telluride crystals - Resonance absorption
1644
Cadmium telluride crystals - Spectra
1643
Cadmium tungstate - Scintillation properties
1594, 1596
Calcite - Electron spin resonance
1640
Calcite - Nuclear spin resonance
293
Calcite - Resonance absorption
1645

Calcite - Single crystals
293
Calcium fluoride crystals - Impurities
809, 810, 813
Calcium fluoride crystals - Paramagnetic resonance
804, 809, 810
Calcium fluoride crystals - Physical properties
1353
Calcium fluoride crystals - Spectrographic analysis
814
Calcium fluoride crystals - Structure
809, 813
Calcium gallates - Thermal stability
4
Calcium tungstate - Scintillation properties
1594, 1596
Californium (Radioactive) - Decay
2402
Calorimeters - Applications
196
Calorimeters - Design
328, 2482
Calorimeters - Power supplies
1136
Cameras - Track photography
1047
Carbides - Chemical reactions
849
Carbohydrates - Nucleation
2748
Carbon - Nuclear reactions
2081
Carbon - Photoactivation
2084
Carbon black - Surface properties
2908, 2909
Carbon compounds - Biosynthesis
1983, 1984
Carbon compounds - Metabolism
1972, 1980, 1982
Carbon compounds - Molecular structure
2064
Carbon dioxide - Absorption spectra
300
Carbon dioxide - Electronic structure
469
Carbon dioxide - Photochemical reactions
233
Carbon dioxide - Photolysis
233
Carbon dioxide - Physiological effects
1077
Carbon dioxide - Relaxation time
1269
Carbon dioxide - Shock waves
1266
Carbon isotopes - Beta decay
2298
Carbon isotopes - Detection
270
Carbon isotopes - Excitation
667, 668
Carbon isotopes - Hyperfine structure
1705
Carbon isotopes - Muon capture
2298
Carbon isotopes - Production
446
Carbon isotopes - Resonance
667
Carbon monoxide - Chemical reactions
724, 826, 828
Carbon monoxide - Spectra
1059, 2950
Carbon tetrachloride - Physical properties
1065
Carbon tetrachloride - Polarization
563
Carbon tetrachloride - Raman spectra
563
Carbonyl radicals - Chemical reactions
1649
Carboxylates - Pyrolysis
2858
Card games - Theory
1312
Cardiovascular system - Chromatographic analysis
2976
Cardiovascular system - Nitroglycerin effects
2417
Catalysis - Mathematical analysis
6, 7
Catalysis - Mechanism
1685, 2184, 2195, 2203
Catalysis - Theory
53-55, 2200
Catalysts - Surface properties
53-55
Catechol amine excretion - Insulin stimulation
1290
Catechol amines - Brain storage
1127, 1130, 1131
Catechol amines - Chromatographic analysis
1076
Catechol amines - Psychophysiological effects
621, 622
Catechol amines - Storage
1122, 1123
Catechol amines - Synthesis
1131
Catechol amines (Rabbit) - Brain storage
1129
Cathodes - Design
1357, 2607
Cathodes - Electrical properties
1357, 1530
Cats - Physiological sleep
722
Celestial mechanics - Bodies of revolution
2264
Celestial mechanics - Mathematical analysis
2261, 2263
Celestial mechanics - Motion
2262
Celestial mechanics - Space curvature
2263
Cell growth - Mathematical analysis
1494

Subject Index

Cells (Biology) - Biophysics
1289
Cells (Biology) - Chemistry
1037
Cells (Biology) - Intracellular constituents
820
Cells (Biology) - Responses
1458
Central nerve tissue (Rabbit) - Light stimulation
1287, 1291
Central nerve tissue (Rabbit) - Single unit activity
1287
Central nerve tissue (Rabbit) - Temperature sensitivity
1291
Central nervous system - Comparative anatomy
108-126
Central nervous system - Drug effects
1016-1019
Central nervous system - Hormonal stimulation
2092, 2975
Central nervous system - Neuraminic acid effects
2531
Central nervous system - Physiological factors
190-192
Central nervous system - Stimulation
190, 192, 2464
Central nervous system (Cat) - Anesthetic effects
1288
Central nervous system (Cat) - Estrogen effects
1570
Central nervous system (Cat) - Stimulation
1288
Ceramic materials - Ductility
326
Ceramic materials - Stresses
324
Ceramics - Ferroelectric properties
1625
Ceramics - Ferromagnetic properties
1625
Cerebral cortex - Nerve impulses
1155
Cerebral cortex (Cat) - Telestimulation
1658
Cerebral cortex (Rat) - Blood vessels
2791
Cerenkov radiation - Theory
2784
Cesium - Ionization
1436
Cesium chloride crystals - Phase transition
1352
Cesium compounds - Combustion
71
Cesium iodide crystals - Scintillation properties
2852
Cesium ions - Plasma physics
1446, 2765
Cesium ions - Production
1831, 1832
Cesium ions - Spectra
1703, 2765
Cesium-iron-chloride complexes - Dissociation
495
Cesium plasmas - Electromagnetic fields
2314
Charged particles - Source
1512
Chelate compounds - Buffering effects
1841
Chelating agents - Methylnioxime
45, 46
Chemical analysis - Methods
349
Chemical bonds - Analysis
932, 1722, 2127
Chemical bonds - Electronegativity
2991
Chemical bonds - Energy
2495, 2496, 2805, 2806
Chemical bonds - Inductance
2805, 2806
Chemical bonds - Measurement
2808
Chemical bonds - Stability
1717
Chemical bonds - Theory
2804
Chemical diffusion - Mathematical analysis
871
Chemical equilibrium - Analysis
2425-2428, 2430-2432
Chemical equilibrium - Mathematical analysis
2163
Chemical indicators - Calcein W
865
Chemical kinetics - Temperature factors
346
Chemical Kinetics of Propulsion - Symposium
707
Chemical reactions
see also specific types of reactions, e.g., Oxidation - reduction reactions
Chemical reactions - Acid catalysis
823-825, 828
Chemical reactions - Acoustic factors
40
Chemical reactions - Analysis
1649, 2290, 2466, 3035
Chemical reactions - Explosive conditions
2340
Chemical reactions - Kinetics
40, 709, 957, 1087, 1088, 1718, 1721, 1723, 1724, 1766-1768, 2197, 2200, 2836, 2857, 2860, 2861
Chemical reactions— Mathematical analysis
1270, 1609, 1782, 2936
Chemical reactions - Mechanisms
822-825, 827, 828, 1137, 2199, 2470, 2836
Chemical reactions - Thermodynamics
558, 2163
Chemisorption - Thermodynamic properties
2193
Chemoceptors - Sham rage effects
2464
Chloralose - Physiological effects
1153-1156, 1160, 1163-1165, 1165-A, 1167-1170
Chlorella - Photosynthesis
2731

Chlorides - Crystal structure
2808
Chlorides - Physical properties
2807
Chlorine resonance - Zeeman splitting
2121
Chloroamminerhodium salts - Synthesis
1883
Chlorobenzene - Dielectric relaxation
625
Chlorophylls - Photochemical reactions
1704
Chlorothiatriazole - Synthesis
598
Chlorpromazine - Blocking properties
1962
Chlorpromazine - Properties
1960, 1961
Cholesterol (Chicken) - Hepatic synthesis
866
Chromatographic analysis - Applications
1893
Chromatographic analysis - Split temperature column
835
Chromatography - Instrumentation
101, 2857
Chrome alum - Physical properties
1411
Chromium - Excitation temperature
1621
Chromium - Spectra
1621
Chromium alloys - Heat content
330
Chromium compounds - Catalytic properties
959
Chromium crystals - Hyperfine structure
812
Chromium ions - Electron spin resonance
1642
Chromium ions - Hyperfine structure
1642
Chromium ions - Line spectrum
812
Chromium ions - Magnetic resonance spectra
748
Circadian rhythms - Heavy water effects
2227
Circadian rhythms - Measurement
1289, 2994-2997
Circadian rhythms - Oscillatory properties
2226
Circadian rhythms - Theory
1114, 2226
Circadian rhythms - Variations
2225
Circuitry models - Mathematical analysis
1513-1515
Citrates - Metabolism
1978
Clays - Crystal structure
1344
Cleavage reactions - Mechanisms
3036
Clock paradox - Nuclear vibrations
862
Cloud chambers - Photography
1047
Clutter spectra - Sea surfaces
857
Coatings - Heat transfer
1320
Coatings - Physical effects
1569
Cobalt - Electron scattering
2574
Cobalt - Electron spin resonance
1714
Cobalt - Neutron cross sections
2853
Cobalt - Spectrophotometric analysis
865
Cobalt alloys - Heat content
330
Cobalt compounds - Crystal structure
2794
Cobalt isotopes - Stripping properties
1373
Cobalt isotopes (Radioactive) - Beta particles
3023
Cobalt oxides - Electrical properties
92
Cobalt oxides - Physical properties
1345
Cocaine - Physiological effects
1075
Coding - Two-way channels
1507
Coenzymes - Spectra
2514
Coherent scattering - Measurement
2891
Coils - Test methods
2132
Cold Acclimation - Symposium
648
Colloids - Electrostatics
29, 30, 2473
Color centers - Properties
886-888
Color centers - Spin resonance
1646
Color Centers and Crystal Luminescence - Symposium
991
Color vision - Analysis
1013, 2837
Color vision - Physical factors
996
Color vision - Physiological factors
995, 1012
Color vision - Psychophysical factors
993
Color vision - Stimulation
1000
Colorimetry - Computer analysis
1839
Colors - Perception
2837

Subject Index

Combinatorial analysis
see also separate Mathematical Subject Classification, p. 903
Combinatorial analysis - Applications
1855, 1857, 1861, 1862, 1864, 1867
Combustion - Analysis
1322-1324, 2207-2209, 2501
Combustion - Chemical kinetics
27, 963, 2197
Combustion - Chemistry
68
Combustion - Detonation
1606
Combustion - Initiation
2207
Combustion - Ion concentration
2761
Combustion - Mathematical analysis
1104, 1830, 2662, 2663
Combustion - Photographic analysis
302
Combustion - Pressure factors
17
Combustion - Stability
17-19
Combustion - Supersonic flow
647
Combustion - Symposium
526, 527
Combustion chambers - Gas flow
2164
Combustion chambers - Geometry
18, 1831
Combustion chambers - Ion concentration
2759
Combustion chambers - Pressure oscillations
2307, 2308
Combustion chambers - Scaling
18
Combustion chambers - Thermodynamics
2760, 2761
Combustion chambers - Turbulence
2767
Combustion of Solid Propellants - Symposium
72
Communication systems - Analysis
1507
Communication systems - Coding
1427, 1462, 1501, 1542
Communication systems - Feedback systems
1507
Communication systems - Handwriting
1510
Communication systems - Mathematical analysis
1460, 1462
Communication systems - Noise reduction
1503
Communication systems - Performance
1465
Communication systems - Processing
1431
Communication systems - Random channels
1496
Communication systems - Reliability
1542, 2643
Communication systems - Signal-to-noise ratio
355, 1496, 1505
Communication systems - Theory
355, 1460, 1519, 2469, 2633
Communication systems - Two-way channels
1493, 1507
Communication systems - Varying channels
1508
Communication theory - Mathematical analysis
1788
Commutators - Mathematical analysis
779
Comparative Bioelectrogenesis - Symposium
148
Complex compounds - Crystal structure
1951, 1952, 1954, 1955, 2120
Complex compounds - Hydrolysis
2429
Complex compounds - Molecular structure
2425
Complex compounds - Preparations
1650
Complex ions - Hydrolysis
2425, 2428, 2432
Complex ions - Raman spectra
560
Complex variables
see also separate Mathematical Subject Classification, p. 903
Complex variables - Analytical functions
2260
Composite materials - Composition
1569
Composite materials - Strength
1569
Compressible flow - Boundary layer
2221
Compressible flow - Heat transfer
313, 1297
Compressible flow - Laminar boundary layer
313
Compressible flow - Mathematical analysis
2198, 2221
Compressible structures - Buckling
2344
Compressible structures - Properties
2343
Compressor blades - Stalling
589
Compressors - Performance
212
Compton scattering - Tables
2875
Computer programming - Absorption correction
2054
Computer programming - Analysis
1483
Computer programming - Arrays
2089
Computer programming - Linearization methods
2055

Computers
see also Mathematical computers
Computers - Applications
132, 1281, 1282, 1312, 1454, 1483, 2088, 2091, 2186, 2349, 2699, 2875
Computers - Storage
2089, 2090
Condensation reactions - Low temperature
708
Conditioned reflex - Inhibition
2418
Conditioned reflex - Investigation methods
2102
Conditioned reflex - Mathematical analysis
1526
Conditioned reflex - Vision
955
Conductivity
see also as a subdivision, e.g., Crystals - Conductivity
Conductivity - Mathematical analysis
753
Conductivity - Measurement
841, 1349, 1681, 2929
Conductors - Applications
1359
Conformal mapping
see separate Mathematical Subject Classification, p. 903
Conical bodies - Deformation
2713, 2714
Conical bodies - Heat transfer
1694
Conical bodies - Hypersonic flow
2220
Conical bodies - Mathematical analysis
1414
Conical bodies - Pressure effects
2713, 2714
Conical bodies - Theory
342
Conical shells - Deformation
2712
Conical shells - Pressure effects
2712
Consonants - Frequency analysis
1638
Control systems
see also Sampled-data control systems
Control systems - Analysis
523
Control systems - Asymptotic stability
267
Control systems - Circuits
1785, 2634
Control systems - Design
858-861, 1786, 1789, 1792, 2186
Control systems - Learning model approach
360
Control systems - Linear processes
860, 861
Control systems - Mathematical analysis
281, 285, 289, 291, 355-357, 359-364, 745, 1785-1787, 1790, 1791, 2188-2190, 2348, 2566, 2567, 2634
Control systems - Performance
1787, 2348, 2566
Control systems - Statistical analysis
2648
Control systems - Synthesis
361-363, 745
Control systems - Theory
1786, 1793, 2189, 2635
Convection - Mathematical analysis
739, 740
Convective flow - Photographic analysis
736
Coolants - Analysis
1699, 1700
Coolants - Applications
1700
Coolants - Heat transfer
1694
Copper - Chemical reactions
957, 958
Copper - Cyclotron resonance
279
Copper - Gamma rays
2891
Copper - Spectrophotometric analysis
865
Copper - Sulfuration
[illegible]8
Copper chloride - Chemical reactions
1940
Copper compounds - Electrical properties
2916-2919
Copper crystals - Deformation
376
Copper crystals - Emissivity
424
Copper crystals - Fermi surface
167
Copper crystals - Internal friction
565
Copper crystals - Stresses
376
Copper crystals - Thermal conductivity
163
Copper crystals - Ultrasonic analysis
162, 163, 167
Copper-lead alloys - Mechanical properties
1607
Copper-lead alloys - Stresses
1607
Copper oxides - Electrical properties
[illegible]2
Copper salts - Electron spin resonance
1929
Copper surfaces - Ionic emission
572
Copper-zinc alloys - Electrical resistance
163
Copper-zinc alloys - Thermal conductivity
163

Subject Index

Coronene - Molecular structure
1907
Corpus callosum - Surgery
2108
Correlation energy - Atoms
931
Correlation energy - Electrons
931
Correlation functions
see also separate Mathematical Subject Classification, p. 903
Correlation functions - Applications
1280, 1286, 1292
Correlation functions - Determination
2005
Corundum
see also Sapphires
Corundum - Paramagnetic resonance
805
Cosmic radiation - Flux
2883
Cosmic radiation - Forbush decrease
2460
Cosmic radiation - Heavy nuclei
1135
Cosmic radiation - Measurement
2459
Cosmic radiation - Satellite observations
1179
Cosmic radiation - Sidereal anisotropy
2461
Cosmic radiation - Solar effects
2883
Cosmic ray bursts - Detection apparatus
2460
Cosmic ray bursts - Intensity
2457, 2460
Cosmic ray showers - Density spectrum
2665, 2667
Cosmic ray showers - Measurement
611, 612, 2665, 2667
Cosmic rays - Alpha particles
447, 2405, 2884
Cosmic rays - Fragmentation
2666
Cosmic rays - Geophysical factors
1224, 1823
Cosmic rays - Intensity
611, 612, 1377, 2456-2461
Cosmic rays - Measurement
444-447, 450, 452, 1371, 1384, 2455
Cosmic rays - Primary
447
Cosmic rays - Solar flares
448, 451
Cosmic rays - Spectra
1777
Cosmic rays - Spectrum analyzers
2665, 2667
Cosmic rays - Theory
1224, 1228
Cosmic rays - Van Allen belt
1222, 1224
Cosmic showers - Analysis
1777
Couette flow - Analysis
2485
Cratering - Mechanism
2831
Creep - Analysis
2149
Creep - Mathematical analysis
2147, 2525
Creep - Test equipment
2526
Creep - Test methods
1896
Creep - Theory
2523
Cryogenics
2334, 2337
Cryostats - Instrumentation
2537
Crystal lattices - Mathematical analysis
1236, 1327, 1329, 2002, 2066, 2936
Crystal structure - Analysis
2429, 2597, 2911-2913, 2980, 2981
Crystal structure - Computer analysis
2067
Crystal structure - Damping effects
870
Crystal structure - Deformation
875, 877, 2080
Crystal structure - Determination
846, 1353, 1356, 2799, 2802
Crystal structure - Diffusion
854
Crystal structure - Mathematical analysis
419, 1216, 1354, 1484
Crystal structure - Neutron diffraction
2070
Crystal structure - Phase transitions
2058, 2794, 2796
Crystal structure - Plasticity
877
Crystal structure - Review
2432
Crystal structure - Spectrographic analysis
1213, 1585
Crystal structure - Theory
419
Crystal structure - X-ray analysis
846, 1067, 1344, 1592, 1952-1954, 2057, 2060, 2396, 2798, 2800, 2803, 2808, 2905
Crystallography - Absorption correction
2054
Crystallography - Information retrieval
2027-2029, 2031-2053, 2056
Crystals
see also Single crystals
see also specific crystals, e.g., Sodium iodide crystals
Crystals - Atomic scattering factors
2055
Crystals - Color centers
886-888, 893

Crystals - Conductivity
2061
Crystals - Deformation
352-354, 879, 1902, 2079, 2080
Crystals - Diamond structure
874
Crystals - Dielectric properties
2061
Crystals - Diffraction data
1836, 1837
Crystals - Diffusion
854
Crystals - Dislocations
879
Crystals - Distortions
2001, 2124
Crystals - Ferromagnetic properties
2122
Crystals - Growth
86, 720, 1611
Crystals - Lattices
1212, 1213, 1216, 2437, 2913, 2914
Crystals - Magnetic properties
1329
Crystals - Mathematical analysis
1244
Crystals - Mechanical properties
322
Crystals - Molecular structure
1211, 1583
Crystals - Phase transitions
2413
Crystals - Spectra
1835
Crystals - Surface properties
1611
Crystals - Temperature factors
1144, 1145, 1147
Crystals - Theory
2002
Crystals - Thermodynamic properties
894, 1145, 1147, 1148, 1212, 1814
Crystals - Vibration
1213
Crystals - X-ray analysis
1146, 1148, 2001, 2002
Crystals - Zone refining
895
Crystals (Enzymes) - Preparation
1941
Cuprous oxide crystals - Growth
2915, 2916
Cyanide ions - Chemical reactions
2288
Cyanides - Crystal structure
755
Cyanides - Spectra
560, 2962
Cyanides - Temperature factors
2962
Cyanines - Stereochemistry
400, 401
Cyanogen bromide - Millimeter wave transitions
639
Cybernetics - Electroencephalography
1744
Cyclic compounds - Photochemistry
2985, 2986
Cyclic compounds - Properties
2475
Cyclic compounds - Reaction mechanism
2471
Cyclic compounds - Spectrographic analysis
1709
Cyclic compounds - Stereochemistry
2471
Cycloalkanones - Electron transitions
2985
Cyclodextrins - Chemical reactions
1696
Cyclooctatetraene - Nuclear resonance
500
Cyclooctatetraene - Nuclear spins
500
Cyclopentadienyls - Hyperfine structure
1709
Cyclopropane - Electron diffraction analysis
1908
Cyclopropane - Molecular structure
1908
Cyclopropane - Spectra
1908
Cyclopropene - Molecular structure
2903
Cyclotron radiation - Analysis
902, 1441, 1490, 1491, 1529
Cyclotron resonance
see as a subdivision, e.g., Metals - Cyclotron resonance
Cyclotrons - Electron source
902
Cylinders - Aerodynamic characteristics
313, 319
Cylinders - Boundary layer control
528, 529
Cylinders - Fluid flow
1335
Cylinders - Heat transfer
313, 319, 2524
Cylinders - Pressure distribution
313, 319
Cylinders - Torsion
600
Cylinders - Virtual mass
1335
Cylindrical bodies - Aerodynamics
314
Cylindrical bodies - Buckling
1800
Cylindrical bodies - Free molecular flow
317
Cylindrical bodies - Microwave reflection
2468
Cylindrical bodies - Pressure distribution
2769
Cylindrical bodies - Stresses
1806

Subject Index

Cylindrical bodies - Superconductivity
1754
Cylindrical shells - Pressure effects
2711
Cylindrical shells - Stresses
524-A, 600, 2711
Cylindrical shells - Vibration
2165
Cystine - Electron spin resonance
631
Cystine dihydrochloride - Hyperfine structure
641
Cytochrome - Paramagnetic resonance
629
Cytoplasm - Organization
1289

Damping - Theory
2525, 2596
Dark adaptation - Pigment migration
1072
Dark adaptation - Sensitivity
1072
Data - Coding
605
Data coding - Electronic devices
2967
Data coding - Mechanical devices
2967
Data processing systems - Applications
1764
Data processing systems - Coding
1501
Data processing systems - Language
132
Data processing systems - Sampling
1786, 2642
Data processing systems - Techniques
2091
Data sampling - Mathematical analysis
281
Data storage systems - Arrays
2089
Data storage systems - Coding
2088, 2090
Data storage systems - Design
605
Data storage systems - Programming
2088
Data transmission systems - Coding
2638
Data transmission systems - Errors
2638
Data transmission systems - Mathematical analysis
282, 283, 290
Data transmission systems - Sampling
1788
Data transmission systems - Statistical analysis
2633
Decarboxylases - Chemical properties
1985
Decay schemes - Temperature factors
1596
Decision making - Human
1464
Decision making - Test methods
1875
Deformation - Mathematical analysis
1299, 2709
Dehydrogenation - Reaction kinetics
959
Delta wings
see Triangular wings
Density - Determination
2741
Deoxymercuration - Mechanism
1718, 1720, 1724
Desoxycorticosterone - Renal properties
2993
Detonation - Electromagnetic factors
2351, 2352, 2355
Detonation - Flame acceleration
304
Detonation - Initiation
2833
Detonation - Theory
2352
Detonation waves - Analysis
2502
Detonation waves - Bibliography
301
Detonation waves - Mathematical analysis
591
Detonation waves - Measurement
307, 647
Detonation waves - Photographic analysis
309
Detonation waves - Properties
647, 2502
Detonation waves - Stabilization
1605, 1606
Detonation waves - Thermodynamics
301
Deuterated compounds - Chemical reactions
1720
Deuterated compounds - Infrared spectra
1584, 1600, 1719
Deuterated compounds - Paramagnetic resonance
13-15
Deuterated compounds - Spectrographic analysis
1585
Deuterated compounds - Vibrational frequency
1719
Deuterium - Adsorption
2909
Deuterium - Energy
2581
Deuterium - Exchange reactions
1023
Deuterium - Nuclear reactions
2572, 2573
Deuterium - Solubility
2907
Deuterium compounds - Infrared spectra
532
Deuteron cross section - Scattering
773

Deuterons - Angular distribution
1379
Deuterons - Bombardment
1366
Deuterons - Energy level
1372
Deuterons - Inelastic scattering
2579
Deuterons - Magnetic field
1241
Deuterons - Mathematical analysis
2572
Deuterons - Nuclear reactions
1379, 2006, 2911-2913
Deuterons - Photodisintegration
3022
Deuterons - Scattering
1193, 1358, 1367, 1379, 2257
Deuterons - Structure analysis
2572
Dialkylbis(pentafluoroethyl)tin compounds - Synthesis
789
Diamonds - Deformation
874
Diamonds - Electromagnetic properties
87
Diaphragm muscle - Sensitivity
1119
Diarylethyl acetates - Pyrolysis
2860, 2861
Diarylethyl acetates - Reaction kinetics
2860, 2861
Diatomic molecules - Electronic structure
470, 473
Diatomic molecules - Molecular rotation
929, 1211
Diatomic molecules - Molecular structure
473
Diatomic molecules - Vibration
929
Diazomethane - Photolysis
232
Diborane - Chemical reactions
1023, 2340, 2341
Diborane - Pyrolysis
2836
Diboron tetrachloride - Decomposition
2014
Dibromomethone - Molecular structure
754
Dicarboxylic acids - Biochemistry
1973, 1979
Dielectric cones - Energy converter
907
Dielectric cones - Radiation
907
Dielectric tube resonator - Design
905
Dielectrics - Properties
50, 51, 185, 186, 1351, 1625A, 1626, 1627, 1752
Dielectrics - Theory
186
Dielectrics - Wave transmission
1500, 2467
Dienes
see also specific compound, e.g., Butadiene
Dienes - Chemical reactions
133
Diethyl ketone - Photolysis
2399
Diethyl polysulfides - Solvent action
958
Differential equations
see also separate Mathematical Subject Classification, p. 903
Differential equations - Applications
2348, 2566
Differential equations - Theory
2011
Diffraction - Mathematical analysis
1835, 1838, 2410
Diffraction - Polarization factors
1838
Diffraction - Scattering
844
Diffraction gratings - Light patterns
2834
Diffractometer - Design
844
Diffusion
see also as a subdivision, e.g., Ions - Diffusion
Diffusion - Activation energy
855
Diffusion - Anelastic measurement
869
Diffusion - Crystal structure
855
Diffusion - Mathematical analysis
871, 1725
Diffusion - Mechanism
2251, 2253
Diffusion - Theory
460, 461
Diffusion - Tracer analysis
2249
Digital computers
see also Mathematical computers
Digital computers - Applications
1049, 1434, 1479, 1492, 1516, 1523-1525, 1542, 1782, 2562, 2639
Digital computers - Circuits
2641
Digital computers - Crystal analysis
344, 345
Digital computers - Design
2170
Digital computers - Least squares method
344
Digital computers - Programming
286, 345, 1791, 2163, 2164
Digital computers - Psychophysiological data
727
Digital computers - Reliability
2643
Digital computers - Servo systems
523
Digital data - Error exponent
1511

Subject Index

Digital systems - Applications
1786
Dihydropyridines - Spectra
2987
Dihydroxyphenylacetic acid - Storage
1125
Dilatometers - Applications
1345
Dimet..yethane - Solvent action
2896
Dimethyl glyoxime - Applications
2176
Dimethylammonium chloride - Thiophosgenation
597
Dimethylformamide solutions - Electrical properties
863
Dimethylpentadiene - Hydrogenation
1685
Dimethylthiocarbamyl chloride - Synthesis
597
Diodes - Applications
1436
Diodes - Circuits
294, 2170
Diodes - Design
1430
Diodes - Thermionic emission
1448
Diphenylamine - Dielectric relaxation
625
Diphenylether - Dielectric relaxation
625
Diphenylmethane dyes - Electronic spectra
2900
Diphenylpicrylhydrazyl - Specific heat
2534
Diphenylpicrylhydrazyl - Spectra
2528, 2535
Diphosphopyridine nucleotide - Oxidation-reduction reactions
2988
Dipole antennas - Electrical properties
750
Dipole antennas - Theory
749
Disiloxane - Infrared spectra
1025
Disks - Axially symmetric flow
177
Disks - Heat transfer
177
Disks - Stresses
2019
Disks - Sublimation
177
Disks - Thermodynamics
2018, 2019
Dislocations (Crystals) - Diffusion
878
Dislocations (Crystals) - Theory
875, 878
Dispersion relations - Mathematical analysis
377
Dispersion theory - Mathematical analysis
2256-2258
Distributed amplifiers - Design
1826
Disulfides - Photolysis
1137
Diurnal insects - Dark adaptation
1072
Documentation
2970
Documentation - Data analysis
2971, 2972
Documentation - Data recording systems
2046, 3046
Documentation - Instrumentation
605, 2032
Documentation - Punched card methods
2027, 2032, 2056
Documentation - Theory
2969, 2974, 3047
Documentation systems - Reliability
2973
Documentation systems - Statistical analysis
2973
Dodecahedrons - Molecular structure
2120
Dopamine - Metabolism
1122, 1131
Dopamine - Storage
1126, 1128, 1129
Dopamine (Rabbit) - Brain storage
1129
Drag - Mathematical analysis
1331
Drops - Atomization
103
Drops - Combustion
1830
Drops - Electrostatic precipitation
29, 30
Drops - Evaporation
103
Drops - Photographic analysis
103
Drugs - Anesthetic effects
1016-1018
Drugs - Physiological effects
129, 645, 1074, 1075, 1971
Ductility - Measurement
1569
Dyes - Physical properties
2899
Dyes - Spectra
2899, 2900
Dynamics - Statistical analysis
1813
Dysprosium - Hyperfine structure
818
Dysprosium - Resonance absorption
818
Dysprosium ions - Hyperfine structure
810
Dysprosium ions - Paramagnetic resonance
810

Dysprosium oxide - Resonance absorbers
818

Ear - Electrical responses
1495
Ear (Frog) - Lesions
1661
Ear (Inner) - Physiological properties
1112
Earth - Magnetic effects
1823
Earth - Radiation belt
1222, 1224
Earth satellites (Artificial) - Applications
1179, 1456
Earth satellites (Artificial) - Theory
2154
Earthquakes - Detection
230
Earthquakes - Rayleigh waves
230
Ebulliscopes - Applications
196
Echo ranging - Measurement
2272
Echo ranging - Test results
2271
Echolocation (Rats) - Theory
1111
Education - Reaction (Psychology)
59
Education - Training devices
57, 58
Elastic beams - Theory
538
Elastic constants - Measurement
1502
Elastic materials - Stresses
1319
Elastic scattering - Mathematical analysis
276, 773, 1406, 2878, 2954
Elastic scattering - Perturbation theory
377
Elasticity
see also as a subdivision, e.g., Films - Elasticity
Elasticity - Dynamic effects
2343
Elasticity - Initial stresses
2346
Elasticity - Mathematical analysis
617, 618, 1230, 1253, 1254, 1256-1259, 1602, 1679, 1800, 1803, 1805, 1806, 2521, 2523, 2708
Elasticity - Measurement
2474
Electric arcs - Performance
2856
Electric bridges - Design
2333
Electric charge - Motion
1820
Electric currents - Mathematical analysis
2128
Electric discharges - Applications
2015, 2128, 2476
Electric discharges - Electrode properties
2358, 2646
Electric discharges - Propagation
2641
Electric discharges - Properties
1991
Electric fields - Frequency
2311-2313, 2315-2318
Electric fields - Mathematical analysis
2002, 3024
Electric fields - Theory
1625A, 1626
Electric potential - Determination
927
Electric potential - Theory
413-415
Electric propulsion - Colloidal systems
29, 30
Electric propulsion - Design
2762-2764
Electric propulsion - Gas ionization
2128
Electric propulsion - Plasma devices
81-84
Electrical circuits - Design
1428, 1517, 1787, 1826, 2355, 2638
Electrical circuits - Mathematical analysis
1021, 2172, 2173, 2178, 2645
Electrical circuits - Operation
1517, 1792
Electrical conductance - Measurement
2132
Electrical Conductivity in Organic Solids - Symposium
313
Electrical impedance - Measurement
1562, 2333
Electrical networks - Analysis
2169
Electrical networks - Coding systems
2186
Electrical networks - Design
1136, 1498, 2188, 2634
Electrical networks - Errors
911
Electrical networks - Impedance
910, 1562
Electrical networks - Ladder
2169
Electrical networks - Mathematical analysis
909-911, 913, 916-921, 1468, 1478, 1785, 2171, 2185, 2187, 2596
Electrical networks - Nonreciprocal
280
Electrical networks - Performance
1468, 2185
Electrical networks - Synthesis
908-910, 912-915, 918, 920, 2171, 2191
Electrical networks - Theory
912, 2191, 2634, 2641
Electrical potentials - Brain habituation
2105

Electrical potentials - Brain stimulation
1527
Electrical potentials - Nerve stimulation
1527
Electrical stimulation (Cat) - Perception
2117
Electrocardiography
2730
Electrochemistry - High temperature research
62
Electrochemistry - Oxidation-reduction reactions
1652-1655
Electrochemistry - Reaction kinetics
1840
Electrochemistry - Theory
2135
Electrode Processes - Symposium
646
Electrodermal responses - Measurement
97
Electrodermal responses - Test methods
190, 192
Electrodes - Acoustic factors
156
Electrodes - Applications
951, 1531, 2463
Electrodes - Electrical properties
1820, 2135, 2358, 2360
Electrodes - Heat transfer
213, 214
Electrodes - Materials
1444
Electrodes - Performance
1444, 2306
Electrodes - Single crystals
2135
Electroencephalograph - Design
953
Electroencephalographic arousal - Tone
950
Electroencephalography - Analysis
96, 1280, 1281, 1286, 1292
Electroencephalography - Applications
1964, 1967-1969, 2418
Electroencephalography - Autocorrelation
1280
Electroencephalography - Coding
96
Electroencephalography - Computers
1281
Electroencephalography - Equipment
189, 953
Electroencephalography - Olfactory stimulation
2109
Electroencephalography - Photic stimulation
2109
Electroencephalography - Photographic analysis
953
Electroencephalography - Statistical analysis
1171
Electroencephalography - Test methods
2103, 2104
Electroerosive machining - Brass
686
Electrolytes - Conductivity
753
Electromagnetic fields - Mathematical analysis
1477, 2541, 2719, 2725, 2727, 2728
Electromagnetic fields - Photon density
508
Electromagnetic fields - Theory
1956, 2408, 2650, 2718
Electromagnetic waves
see also Microwaves
Electromagnetic waves - Mathematical analysis
211, 215, 508, 1264, 1499, 1540, 1959, 1993, 2408, 2543, 2605, 2622
Electromagnetic waves - Physical factors
1769
Electromagnetic waves - Propagation
211, 215, 1431, 1447, 1809, 1917, 1990, 1993, 2314, 2622, 2624, 2627, 2628
Electromagnetic waves - Radiation
1437
Electromagnetic waves - Scattering
857, 2543
Electromagnetic waves - Spectrographic analysis
2410
Electromagnetism - Mathematical analysis
1880
Electron accelerators - Performance
1996
Electron beams - Applications
1446, 1918, 2772-2774
Electron beams - Focusing
1997, 2606
Electron beams - Kinetic theory
1944
Electron beams - Mathematical analysis
2600, 2603, 2604, 2605, 2961
Electron beams - Noise
1461, 2637
Electron beams - Production
902, 1916
Electron beams - Radiation
907, 1945-1947, 2586, 2590, 2599
Electron beams - Scattering
2546
Electron beams - Theory
2600, 2609
Electron collisions - Applications
1426
Electron collisions - Mathematical analysis
2492, 2493
Electron collisions - Microwave spectroscopy
1425
Electron gas - Properties
1214, 1218, 1219
Electron gas - Theory
1238
Electron guns - Design
570
Electron guns - Electron source
570
Electron guns - Mathematical analysis
1916
Electron lenses - Design
1359

Electr[illegible]roscopy - Applications
[illegible], 1424, 1656, 1657, 1903
Elec[illegible]multipliers - Secondary emission
923
Electron oscillation - Mathematical analysis
1214
Electron scattering - Diffraction measurements
1909
Electron spin - Relaxation time
2683, 2889
Electron spin resonance - Bibliography
634
Electron spin resonance - Hyperfine structure
503, 1705, 1708
Electron spin resonance - Polarization effects
1641
Electron spin resonance - Research techniques
1182-1184
Electron spin resonance - Spectra
1183, 1186-1188, 1643, 1702, 1707, 1727, 1929, 2514, 2527, 2529, 2532, 2892, 2893
Electron spin resonance - Theory
503, 504, 1182
Electron spin resonance - Transitions
1716
Electron tubes - Circuits
294
Electron tubes - Design
1916, 2607
Electron tubes - Noise parameters
1834
Electron tubes - Theory
2603, 2604, 2608
Electronic circuits - Filters
914
Electronic circuits - Mathematical analysis
914, 922
Electronic circuits - Synthesis
914
Electronic commutators - Applications
927
Electronic equipment - Design
2649
Electronic recording systems - Design
956
Electronic switches - Mathematical analysis
2566, 2567
Electrons - Absorption
2497
Electrons - Applications
2569
Electrons - Bombardment
1386, 1556
Electrons - Correlation energy
931
Electrons - Cyclotron radiation
1563
Electrons - Decay
1039-1041, 1227, 2549, 2565
Electrons - Density
932, 1349, 1409, 1410, 2476, 2489, 2491, 2629, 2631, 2665, 2667
Electrons - Diffusion
1265, 1271, 1272, 1275, 1680
Electrons - Emission
2873
Electrons - Energy
1214, 1217, 1425, 1471, 1932, 2413, 2575, 2593, 2448-2450, 2596, 2603, 2605, 2815
Electrons - Excitation
1218, 1426
Electrons - Impact theory
3012
Electrons - Motion
1217, 1233, 1264, 2590, 2600, 2603, 2609
Electrons - Nuclear reactions
2304, 2558, 2561, 2564, 2683
Electrons - Photoelectric effects
2544
Electrons - Polarization
2696, 2890, 2900, 3023
Electrons - Power source
1357
Electrons - Production
923
Electrons - Properties
1541, 2026, 2965
Electrons - Resonance
1182, 2900
Electrons - Scattering
276, 568, 889, 1218, 1597, 2084, 2448-2450, 2546, 2564, 2573-2576, 2584, 2585, 2589, 2591, 2592, 2594, 2693, 2696, 2954
Electrons - Spectra
1351, 1455, 2812, 2814, 2820, 2901, 2902
Electrons - Structure analysis
2578
Electrons - Surface reactions
2026
Electrons - Transition energies
2[illegible]5
Electrons - Velocity
1530
Electroshock - Test methods
1735
Electrostatic fields - Mathematical analysis
2453
Electrostatic generators - Electric fields
2829
Electrostatic loudspeakers - Design
1432
Electrostatics - Mathematical analysis
2606
Elementary particles
see Particles; specific elementary particles, e.g., Electrons
Emotions - Electrical stimulation
2463
Emotions - Hostility
2755, 2758
Emotions - Test methods
2464, 2758
Employee relations - Analysis
973
Endocrines - Central nervous system
98
Endocrines - Thyroid glands
99, 100, 102, 1078

Subject Index

Endolymph - Properties
1112
Energy - Internuclear measurement
3015
Energy - Mathematical analysis
2495, 2754
Energy conversion - Instrumentation
1448
Energy potentials - Mathematical analysis
2946, 2947, 2953
Energy spectra (Protons) - Analysis
1226
Enthalpy - Measurement
204
Entropy
see also the subdivision Thermodynamics, e.g., Chemical reactions - Thermodynamics
Entropy - Mathematical analysis
3038
Enzymes
see also specific enzymes, e.g., Decarboxylases
Enzymes - Biochemistry
1988
Enzymes - Crystallization
1941
Enzymes - Determination
1975
Enzymes - Properties
1124, 1983, 1984, 2983
Enzymes - Purification
1983
Enzymes - Reaction kinetics
1124, 1978, 1989
Enzymes - Synthesis
1977, 2982
Epinephrine - Adrenal medulla storage
1128
Epoxides - Synthesis
3035
Equilibrium
see Chemical equilibrium
Erosive burning
see the subdivision Combustion, e.g., Solid propellants - Combustion
Escherichia - Metabolism
1980, 1981
Esters - Pyrolysis
2857-2860
Esters - Stability
2857, 2860
Ethane - Sound transmission
966, 967
Ethers - Basicities
2989
Ethyl fluorides - Microwave spectra
534
Ethyl fluorides - Molecular structure
534
Ethyl phenylpropiolate - Stereochemistry
2292
Ethyl radicals - Electronegativity
506
Ethylene - Chemical reactions
2016
Ethylene - Electronic structure
469
Ethylene - Luminescence
232
Ethylenediaminetetraacetic acid - Acid salts
2287, 2289
Ethylenediaminetetraacetic acid - Dissociation
2287, 2289
Ethylenedinitrilo-tetraacetate ions - Chemical reactions
2288
Euglena - Circadian rhythms
2227
Europium ions - Spectrographic analysis
814
Evaporation - Mathematical analysis
24
Evaporation - Measurement
2201
Evaporators - Design
1564
Exchange reactions - Kinetics
1023
Excisions (Brain) - Learning impairment
1965
Excitation energy - Mathematical analysis
2562
Exhaust flames - Ionization
2759
Exploding wires - Shock waves
1817
Explosions - Mathematical analysis
591
Explosions - Physical effects
2340
Explosives - Detonation
2832
Eye - Electrical properties
993, 999, 1003, 1008-1011
Eye - Sensitivity
1012
Eye - Stimulation
993, 996, 998, 999, 1001, 1003-1006, 1008, 1010-1012, 1421, 1422
Eye pigments - Physiology
1012

Factor analysis
see separate Mathematical Subject Classification, p. 903
Fatigue (Metallurgy)
2021, 2437
Fatigue (Metallurgy) - Statistical analysis
2775
Feedback amplifiers - Design
1506, 1792
Fermi Surface of Metals - Symposium
713
Fermions - Mathematical analysis
261, 752
Fermions - Nuclear reactions
259, 2692
Fermions - Quantum mechanics
138, 2692

Fermions - Scattering
2693
Fermions - Superconductivity
261
Ferric ions - Magnetic resonance spectra
748
Ferric ions - Paramagnetic resonance
807
Ferrite resonators - Dipolar coupling
903, 904
Ferrite resonators - Magnetodynamic properties
903
Ferrite resonators - Spectra
904
Ferrites - Electromagnetic properties
1347
Ferrites - Magnetic properties
1355
Ferrites - Physical properties
2177
Ferrites - Spectra
1675
Ferrites - Synthesis
1342
Ferrocenes - Chemical reactions
2290
Ferroelectric crystals - Dielectric properties
1625A - 1627
Ferroelectric crystals - Spectra
1627
Ferroelectric crystals - X-ray analysis
2057, 2058, 2060-2063, 2068, 2069
Ferroelectric materials - Reaction kinetics
1625
Ferromagnetic alloys - Magnetic properties
985
Ferromagnetic crystals - Anisotropy
2122
Ferromagnetic crystals - Impurities
1243
Ferromagnetic crystals - Magnetic properties
1243
Ferromagnetic crystals - Mathematical analysis
1243
Ferromagnetic crystals - Resonance
743
Ferromagnetic materials - Diffusion
869, 880
Ferromagnetic materials - Magnetic properties
979
Ferromagnetic materials - Radiation effects
980, 982
Ferromagnetic materials - Reaction kinetics
1625
Ferromagnetic materials - Resonance
746, 1355, 1443
Ferromagnetic materials - Specific heat
742
Ferromagnetism - Mathematical analysis
1443
Ferromagnetism - Theory
1674
Ferrous ions - Paramagnetic resonance
806
Field emission - Analysis
2607
Field emission spectroscopy - Metals
571
Field emission spectroscopy - Solids
571
Field theory
see also as a subdivision, e.g., Quantum mechanics - Field theory
Field theory - Mathematical analysis
1844, 1848, 2266, 2887, 2888
Film thickness - Measurement
568
Films - Aging properties
2473
Films - Elasticity
2474
Films - Surface properties
2474
Films - Ultraviolet polarizers
498
Filters - Channel reception
1519
Finland - Group dynamics
520
Fishes - Biochemistry
148
Fishes - Neurophysiology
148
Fishes - Physiology
148
Flame holders - Wake region
2768
Flame propagation - Photographic analysis
304
Flame propagation - Turbulence
70, 197, 739, 740
Flame spectroscopy - Anion interference
564
Flame velocities - Mathematical analysis
197, 1334
Flame velocities - Measurement
307, 308
Flames - Chemical analysis
961
Flames - Computer analysis
2767
Flames - Free radicals
961, 1783
Flames - Ionization
306, 2742, 2743, 2761
Flames - Kinetics
1115, 1116, 1784, 2197
Flames - Laminar flow
960
Flames - Mathematical analysis
1781, 1783, 1784
Flames - Photographic analysis
70, 302
Flames - Properties
1115, 1781, 1783, 1784, 2742, 2743
Flames - Radiative heat transfer
740

Subject Index

Flames - Spectrographic analysis
1746, 1999
Flames - Stability
1322-1324, 1334
Flames - Tracer analysis
2768
Flames - Theory
1115, 1334
Flight flutter - Simulation
104, 105
Flight flutter - Test methods
104, 105
Flow reactors
see Reactors
Fluid dynamics
1741, 2328
Fluid flow - Acoustic properties
577
Fluid flow - Analysis
1534, 2325, 2485
Fluid flow - Axially symmetrical body
201, 202
Fluid flow - Bosons
141
Fluid flow - Boundary layer
78, 2217
Fluid flow - Catalytic surfaces
7
Fluid flow - Equilibrium
1333
Fluid flow - Heat transfer
1412, 1413, 2484
Fluid flow - Intermixing
2196
Fluid flow - Kinetics
2212
Fluid flow - Magnetic factors
1533, 2131, 2331
Fluid flow - Mathematical analysis
33, 34, 418, 575-577, 585-587, 593, 594, 1231, 1274, 1317, 1335, 1579, 1580, 2158, 2332
Fluid flow - Noise properties
2770, 2771, 2776
Fluid flow - Phase transitions
1829
Fluid flow - Rotating disks
1331
Fluid flow - Shock waves
2224
Fluid flow - Stresses
2707
Fluid flow - Theory
1335
Fluid flow - Thermodynamic properties
155, 751, 1879, 2772, 3021
Fluid flow - Turbulence
416, 1261, 2423, 2424
Fluid flow - Velocity
1755, 1830, 2212
Fluid flow - Viscoelasticity
1579
Fluid flow - Vorticity
576
Fluid injection - Theory
582
Fluid mechanics - Laminar mixing
1737-1739
Fluid mechanics - Mathematical analysis
2005, 2218, 3037, 3038, 3041-3043
Fluid mechanics - Mechanical properties
2423, 2424
Fluid mechanics - Statistical analysis
2724
Fluid mechanics - Theory
1579 - 1581
Fluid mechanics - Turbulent mixing
1736
Fluid mechanics - Viscous flow
2329
Fluids
see also Liquids
Fluids - Boundary conditions
2330
Fluids - Magnetic relaxation
1598
Fluids - Magnetohydrodynamics
590, 2131
Fluids - Mathematical analysis
201, 202, 3037, 3045
Fluids - Nucleation
2748
Fluids - Pair distribution
3041, 3044
Fluids - Particle theory
3040
Fluids - Singlet distribution
3044
Fluids - Thermodynamic properties
1555, 3042
Fluids - Viscosity
1316, 1317, 1582
Fluids - Viscous flow
575, 576
Fluorescein - Electrolytic dissociation
2809
Fluorescein - Flash photolysis
2809
Fluorescence - Measurement
2398, 2703
Fluoride ions - Spectra
1703
Fluorine - Atomic orbitals
1107
Fluorine - Determination
423
Fluorine - Gamma radiation
662
Fluorine - Nuclear reactions
2081
Fluorine compounds (Organic) - Quantitative analysis
423
Fluoroammonia - Millimeter wave transitions
639
Flutter
see also as a subdivision, e.g., Aircraft - Flutter
Flutter - Analysis
104, 105

Flutter - Theory
200
Foreign policy - Attitudes
515-519
Formic-d acid - Millimeter wave spectrum
643
Formic-d acid - Rotational constants
643
Formyl fluoride - Dipole moment
628
Formyl fluoride - Microwave spectra
626, 626
Fracture (Mechanics) - Analysis
1606
Fracture (Mechanics) - Mathematical analysis
619
Fracture (Mechanics) - Propagation
321, 325, 327
Fracture (Mechanics) - Riveted stiffeners
394
Free molecular flow - Mathematical analysis
317, 2136-2138
Free molecular flow - Stability
1576
Free radicals - Cystine
641
Free radicals - Determination
2516
Free radicals - Electron spin resonance
501, 1707, 2444, 2893, 2695
Free radicals - Electron transitions
203
Free radicals - Exchange systems
2534
Free radicals - Hydroxyl
13, 14
Free radicals - Hyperfine structure
501
Free radicals - Ionization potentials
1022
Free radicals - Molecular structure
642
Free radicals - Paramagnetic resonance
11
Free radicals - Production
235, 637, 1167, 2397, 2695
Free radicals - Proteins
631-633, 641, 642
Free radicals - Radiation effects
637
Free radicals - Reaction kinetics
11, 15, 409, 2636
Free radicals - Resonance
2513, 2515, 2517
Free radicals - Solids
706
Free radicals - Solvent action
964
Free radicals - Spectra
2514, 2529
Free radicals - Substitution reactions
1022
Free radicals - Temperature factors
14
Frequency modulation - Demodulation techniques
1465
Frequency modulation - Reception techniques
1431, 1465
Frequency modulation receivers - Design
1466
Frequency multipliers - Design
2175
Frequency-power formulas - Mathematical analysis
1477
Frequency stabilizers - Design
298
Friction - Measurement
2338
Friction - Stress properties
2060
Friction - Theory
1646
Friction - Welding
2339
Fuel injection - Combustion chambers
103
Fuel sprays - Combustion
962, 963, 1322-1324, 2663
Fuel sprays - Evaporation
2164
Fuel sprays - Interactions
1322-1324
Fuels - Instability
2310
Fulvenes - Chemical reactions
475
Fulvenes - Stability
475
Furnaces - Applications
2934
Furnaces - Design
2931
Furnaces - X-ray photography
737
Furnaces - Zone melting
720

Gadolinium ions - Spectrographic analysis
614
Gadolinium isotopes - Hyperfine structure
1401
Gadolinium isotopes - Magnetic moments
1401
Galaxies - Theory
701
Games
see separate Mathematical Subject Classification, p. 903
Games theory - Analysis
1624
Games theory - Applications
1933, 1934
Games theory - Mathematical analysis
1877
Gamma-ray spectrometers - Design
453

Subject Index

Gamma rays - Angular distribution
1401
Gamma rays - Astronomical sources
2402
Gamma rays - Emission
884
Gamma rays - Measurement
453, 1828, 2813, 2821
Gamma rays - Mössbauer effect
884
Gamma rays - Nuclear polarization
1385, 2875
Gamma rays - Resonance absorption
884
Gamma rays - Scattering
675, 1395, 2891
Gamma rays - Spectrographic analysis
2812
Garnets - Absorption spectra
819
Garnets - Magnetic resonance
743
Garnets - Microwave properties
2597
Garnets - Resonance absorbers
818
Garnets - Specific heat
742
Gas bearings - Stability
688
Gas bearings - Theory
687, 688
Gas chambers - Design
702, 703, 721
Gas chambers - Radiation sensitivity
703
Gas chromatography - Techniques
835
Gas discharge tubes - Applications
2613
Gas discharges - Instrumentation
2701
Gas discharges - Ionization mechanisms
1038
Gas discharges - Mathematical analysis
906, 1039-1041
Gas discharges - Measurement
1992, 2351, 2701, 2703
Gas discharges - Properties
1994
Gas discharges - Radiation
1038
Gas discharges - Spectrographic analysis
2910
Gas discharges - Test methods
1995
Gas dynamics - Applications
2485
Gas dynamics - Chemical reactions
2320
Gas dynamics - Detonation
307
Gas dynamics - Field theory
692
Gas dynamics - Instrumentation
2487
Gas dynamics - Inviscid flow
2322
Gas dynamics - Mathematical analysis
417, 418, 546, 2012
Gas Dynamics - Symposium
1881
Gas dynamics - Theory
5, 140, 975
Gas electronics - Thermal ions
729, 733, 734
Gas flow - Acoustic properties
577
Gas flow - Analysis
9, 1413, 2139, 2214, 2215, 2320, 2325
Gas flow - Boundary layer
1740, 2221, 2898
Gas flow - Density
2773
Gas flow - Heat transfer
2139
Gas flow - Hypersonic nozzles
2738
Gas flow - Hypersonic properties
542
Gas flow - Kinetic theory
1338
Gas flow - Laminar boundary layer
56, 2144
Gas flow - Mathematical analysis
1033, 1338, 1695, 1736, 1738, 1739, 1818, 1819, 2162, 2219, 2324, 2421, 2422, 2433, 2434
Gas flow - Measurement
1033, 2483, 2769
Gas flow - Moisture
2139
Gas flow - Pressure
2307, 2465
Gas flow - Surface properties
2324
Gas flow - Theory
2211
Gas flow - Thermodynamic properties
2139, 2322, 2772, 2774
Gas flow - Turbulence
1736
Gas flow - Velocity
2211, 2465
Gas ionization - Conductivity
214
Gas ionization - Decay
26
Gas ionization - Diffusion
2478
Gas ionization - Electric propulsion
2128
Gas ionization - Equilibrium constants
8
Gas ionization - Kinetics
187
Gas ionization - Mathematical analysis
8, 730, 731, 752, 2829

Gas ionization - Measurement
702, 721, 1577, 2486, 2855
Gas ioniation - Reflection
572
Gas ionization - Peflection
349, 350
Gas ionization - Transport properties
731, 2478
Gas ionization - Viscosity
548
Gas-liquid mixtures - Nucleation processes
721
Gas mixtures - Thermodynamics
1781
Gas turbines - Performance
2214
Gaseous rocket fuels - Chemical composition
2308
Gaseous rocket fuels - Pressure oscillation
2308
Gases - Absorption
712, 868, 1453
Gases - Acoustic properties
40, 546
Gases - Bose system
1273
Gases - Catalytic probes
9
Gases - Convection
739, 740
Gases - Detonation
306, 308, 1605, 1606, 2352
Gases - Dynamics
1559, 1741, 2484, 2485
Gases - Electron transitions
550
Gases - Emission
2979
Gases - Heat transfer
548
Gases - Hypersonic flow
2220
Gases - Ionization
187, 1039, 1274, 1437, 1559, 2128, 2873
Gases - Irreversible processes
689, 693-696, 698
Gases - Kinetic theory
1231, 1740, 2433, 2490, 2493
Gases - Mathematical analysis
171, 205, 278, 1274, 1812, 2223, 2488, 2490
Gases - Optical analysis
1268
Gases - Properties
205, 968, 2192, 2214, 2215, 2701
Gases - Quantum mechanics
183
Gases - Recombination reactions
26, 187, 1998
Gases - Relaxation time
968, 2192
Gases - Shock waves
549, 1621-1623, 2357, 2824
Gases - Sound ttransmission
769, 967, 968
Gases - Spectra
8, 207, 208, 299, 1612, 3013, 3014
Gases - Statistical mechanics
278, 694, 695
Gases - Test equipment
1412
Gases - Thermodynamic properties
718, 970
Gases - Transport properties
183, 184
Gases - Viscosity
171-174
Gases - Wave transmissions
305
Gases (Solid) - Absorption
421
Gases (Solid) - Ultraviolet radiation
421
Gels - Acoustic factors
155
Gels - Photographic analysis
155
Geomagnetic fields - Applications
1226, 1227
Geometrodynamics - Motion
2262
Geometry - Mathematical analysis
1847
Germanium - Atomic structure
2980, 2981
Germanium - Ionization
1471
Germanium - Surface properties
1662
Germanium compounds - Electromagnetic properties
87
Germanium crystals - Antimony doped
466
Germanium crystals - Arsenic doped
467
Germanium crystals - Conductivity
464-467, 741, 894, 1541, 1662, 2930, 2932
Germanium crystals - Gallium doped
467
Germanium crystals - Growth
2933, 2980, 2981
Germanium crystals - Hall coefficients
464
Germanium crystals - Impurities
464-467
Germanium crystals - Phonons
894
Germanium crystals - Shear stress
465, 466
Germanium crystals - Spectra
988, 1727
Germanium crystals - Surface properties
992
Glass - Applications
23
Glass - Photoelastic analysis
182
Glass - Physical properties
1380

Subject Index

Glass - Radiation effects
182
Glass - Surface properties
2194, 2195, 2199
Glass - Ultrasonic analysis
182
Glass seals - Preparation
2632
Glow discharges - Electrode properties
2358
Glow discharges - Measurement
1546
Glucosidase - Purification
2983
Glucosides - Molecular structure
1710
Glycerol - Evaporation
2201
Glycine - Oxidation-reduction reactions
1973
Glycine salts - Crystal structure
2060
Glycine salts - Ferroelectric properties
2063
Glycine salts - Phase transitions
2063
Glycols - Dielectric properties
186
Glycols - Molecular structure
186
Glyoxylic acid dehydrogenase - Enzymatic properties
1983
Gold - Gamma rays
2891
Gold - Neutron production
2854
Gold - Thermal vibrations
67
Gold crystals - Fermi surface
165, 167
Gold crystals - Ultrasonic analysis
165, 167
Gold isotopes - Detection
270
Gold isotopes (Radioactive) - Decay
2577
Gold-nickel alloys - Electron micrographic analysis
684
Gold-nickel crystals - Precipitation
684
Grains (Metallurgy) - Boundary layer
1896
Grains (Metallurgy) - Creep
1896
Grains (Metallurgy) - Growth
680, 683
Grains (Metallurgy) - Microstructure
525
Grains (Metallurgy) - Stresses
1899
Grammar - Properties
1445
Graphite - Friction
1648
Gravitational fields - Mathematical analysis
1846, 1847
Gravitational fields - Measurement
2718
Gravitational theory - Mathematical analysis
2998
Gravity - Mathematical analysis
1756, 1757
Gravity - Physical effects
147
Gravity - Theory
1846-1848, 2545
Grignard reagents - Chemical reactions
849
Group behavior - Individual performance
1772, 1773
Group behavior - Psychological factors
1772, 1773
Group dynamics - Analysis
973, 975
Group dynamics - Behavior
830, 831
Group dynamics - Bisensory stimulation
901
Group dynamics - Communication
767, 768
Group dynamics - Human engineering
830, 831
Group dynamics - Ideological conflict
518-520
Group dynamics - Nuclear attack
832-834
Group dynamics - Performance
1935, 1937
Group dynamics - Psychological factors
369
Group dynamics - Sociological analysis
978, 1797, 2697
Group dynamics - Task assignments
1935
Group dynamics - Time-on-target responses
898
Groups (Mathematics)
see separate Mathematical Subject Classification, p.
Guided missile trajectories - Mathematical analysis
715, 2159
Guns - Characteristics
2826
Gyroscopes - Applications
2542
Gyroscopes - Motion
2003, 2545

Hafnium - Oxidation
1143
Hafnium isotopes - Spin configuration
1393
Half life - Determination
1827
Halocarbons - Molecular structure
2064

Halocarbons - Phase transitions
2064
Halocthanes - Sound transmission
966, 967
Halogen compounds (Organic) - Synthesis
964
Halogen oxyanions - Raman spectra
561
Halomethanes - Preparation
849
Handwriting - Analysis
1510
Harmonic generators - Properties
1995
Harmonic oscillators - Applications
2007
Harmonic oscillators - Mathematical analysis
1239
Harmonic oscillators - Statistical functions
1232, 1239
Hearing (Rats) - Locating systems
1111
Heart - Electrical properties
2730
Heart - Mechanical properties
2730
Heart - Physiology
2730
Heart (Fish) - Physiology
1076
Heart muscle - Biochemical reactions
1076
Heat-resistant glass - Applications
1943
Heat transfer
see also as a subdivision, e.g., Boundary layer - Heat transfer; Sheets - Heat transfer
Heat transfer - Blunt plates
543
Heat transfer - Boundary layer
592, 1412, 1416, 1417
Heat transfer - Catalytic probes
10
Heat transfer - Hypersonic flow
78, 1699, 1700
Heat transfer - Kinetics
2216
Heat transfer - Laminar boundary layer
177, 178, 1694, 1695
Heat transfer - Mathematical analysis
7, 28, 56, 319, 592, 1033, 1339, 1340, 1415, 1418, 3044
Heat transfer - Measurement
161, 175, 177, 178, 548, 1320, 1325
Heat transfer - Radiation
5, 1340, 2524
Heat transfer - Stresses
524
Heat transfer - Vaporization
348
Heat transfer - Vibrational mechanism
2247
Heavy elements - Photoprotons
2569
Heavy water - Properties
2227
Helium - Atmospheric concentration
1412
Helium - Bosons
2886
Helium - Electrical properties
1543
Helium - Energy
1747, 2754, 3015
Helium - Excitation
259, 1944-1947, 2562
Helium - Fluid flow
3021
Helium - Hyperfine structure
3026
Helium - Ionization
2562, 2783, 2784
Helium - Magnetic moments
3026
Helium - Muon bombardment
3030–3032
Helium - Nuclear reactions
2700
Helium - Orbital functions
471
Helium - Shock waves
1266
Helium (Liquid) - Nuclear reactions
1196, 1200
Helium ions - Line spectra
3017
Helium ions - Recombination reactions
1041
Helium isotopes - Atomic energy levels
655
Helium isotopes— Decay
1367
Helium isotopes - Energy levels
3027
Helium isotopes - Excitation
660
Helium isotopes - Inelastic scattering
2594
Helium isotopes - Properties
3030
Hemispherical shells - Heat transfer
1417
Hemoglobin - Paramagnetic resonance
629
Hemorrhage - Analysis
2976
Hexafluoro-metal compounds - Conductance
48
Hexafluoro-metal compounds - Cryoscopic determination
48
Hexamethyldisiloxane - Infrared spectra
193
Hexamethyldisiloxane - Thermodynamic properties
193, 195
Hexanols - Synthesis
3036
High Energy Physics - Symposium
2412

Subject Index

High energy research
1359, 1390, 1399
High pressure research
1346, 2751, 2752
High speed photography - Applications
2831, 2832
High temperature research
1750, 1781, 2522, 2742, 2743, 2919
High temperature research - Instrumentation
711
High temperature research - Test facilities
1701
High Temperature Technology - Symposium
2500
Hormones - Biological assay
794
Hormones - Control mechanisms
2099, 2975
Hormones - Feed-back mechanism
2099
Hormones - Hypothalamic influence
2092-2094, 2096, 2098, 2101
Hormones - Physiological effects
98, 99, 1078, 1570
Hormones - Regulation
2100
Hormones - Study methods
2977
Hormones (Bird) - Reproductive system
389
Human engineering - Computers
132
Hydrates - Crystal structure
1082-1086
Hydrates - Structural analysis
2120
Hydrazine - Decomposition
2203
Hydrazine - Molecular structure
2203
Hydrazine derivatives - Chemical reactions
1568
Hydrazine derivatives - Synthesis
1568
Hydrazoic acid - Photolysis
234
Hydrides - Crystal structure
756
Hydrocarbons - Chlorination
964
Hydrocarbons - Hydrogen ion concentration
236
Hydrocarbons - Kinetics
1137
Hydrocarbons - Molecular structure
236, 2391
Hydrocarbons - Resonance
2513, 2517
Hydrochloric acid - Chemical reactions
1940
Hydrochloric acid - Infrared spectra
1057, 1062
Hydrodynamics - Statistical analysis
2595
Hydrogen - Adsorption
2909
Hydrogen - Atomic orbitals
411
Hydrogen - Collision cross sections
1425
Hydrogen - Cryogenic condensation
708
Hydrogen - Electrical properties
413-415, 1543
Hydrogen - Electron transitions
410, 411
Hydrogen - Energy
928, 929, 2580, 2581
Hydrogen - Hyperfine structure
410
Hydrogen - Inelastic scattering
699
Hydrogen - Ionization
2783, 2784
Hydrogen - Microwave radiation
1546
Hydrogen - Nuclear cross sections
488
Hydrogen - Propellant properties
2134
Hydrogen - Proton cross sections
735
Hydrogen - Recombination reactions
2194, 2195, 2199, 2200
Hydrogen - Resonance
1722
Hydrogen - Solubility
850, 2907
Hydrogen - Spectra
725, 928, 2400
Hydrogen (Liquid) - Nuclear reactions
1195
Hydrogen (Solid) - Free radicals
706
Hydrogen bonds - Properties
2059, 2989, 2992
Hydrogen bonds - Spectra
1094
Hydrogen bonds - Stability
652
Hydrogen cyanide - Dipole moments
627
Hydrogen cyanide - Microwave spectra
627
Hydrogen cyanide polymers - Crystal structure
755
Hydrogen fluoride - Spectra
1746
Hydrogen halides - Conductance
2336
Hydrogen halides - Ionization
2336
Hydrogen ions - Spectra
2957
Hydrogen isotopes - Chemical effects
1768
Hydrogen isotopes (Radioactive) - Decay
1367

Hydrogen molecules - Molecular structure
472
Hydrogen molecules - Orbital functions
471, 472
Hydrogen molecules - Vibration
725
Hydrogen-oxygen mixtures - Detonation
304, 306
Hydrogen peroxide - Dissociation
827, 828
Hydrogen peroxide - Electrochemical behavior
1652-1655
Hydrogen peroxide - Hydrogen bonds
1094
Hydrogen radicals - Stabilization
706
Hydrogen sulfide - Infrared spectra
2903
Hydrogen-d-sulfide - Microwave spectra
486
Hydrogen-d-sulfide - Quadrupole coupling
486
Hydrogen superoxides - Molecular structure
409
Hydrogenation - Diffusional control
1885
Hydrogenation - Mechanism
2014
Hydromagnetic waves - Mathematical analysis
2183
Hydrophones - Calibration
157
Hydroxides - Bonding
2991
Hydroxyl radicals - Electronic transitions
203
Hydroxyl radicals - Paramagnetic resonance
11
Hydroxytryptamine - Ion metabolic effect
332
Hyperfine structure - Determination
272-274, 1426, 1535, 1539
Hyperfine structure - Effect of fluorescence
438
Hyperfine structure - Frequency shifts
3014, 3019
Hyperfine structure - Relaxation
501
Hyperfine structure - Spectrographic analysis
1480, 1481, 1535, 1537, 1548, 1705, 2528, 2529, 2535, 2536, 2892
Hyperons - Absorption
1052
Hyperons - Branching ratios
455, 457
Hyperons - Coupling theory
1191
Hyperons - Decay
1042, 1044, 1046, 1189, 1201, 1590, 2403
Hyperons - Interactions
2406
Hyperons - Masses
1042, 1044, 1046
Hyperons - Nuclear reactions
1191, 1208, 1590, 2700
Hyperons - Nuclear resonance
260
Hyperons - Parity
2700
Hyperons - Production
1050, 1052
Hyperfragments - Decay
1050, 1051, 1054, 2698, 2700
Hyperfragments - Lifetimes
1053
Hyperfragments - Production
1050, 1051, 2698, 2700
Hypersonic flight - Gas dynamics
2322
Hypersonic flow
see also Supersonic flow
Hypersonic flow - Acoustic properties
546, 547
Hypersonic flow - Aerodynamic characteristics
719
Hypersonic flow - Boundary layer
547, 2153, 2323
Hypersonic flow - Heat transfer
2213
Hypersonic flow - Magnetic factors
78
Hypersonic flow - Mathematical analysis
644, 719, 1336, 1740, 2220, 2319, 2489
Hypersonic flow - Separation
314
Hypersonic flow - Theory
542
Hypersonic flow - Ultraviolet radiation
547
Hypersonic flow - Viscosity
2213
Hypersonic nozzles - Heat transfer
2481
Hypersonic shock tunnels - Blunt bodies
545
Hypersonic shock tunnels - Boundary layer
545
Hypersonic shock tunnels - Design
544
Hypersonic wind tunnels - Applications
2486
Hypersonic wind tunnels - Calibration
2483
Hypersonic wind tunnels - Design
644, 1701, 2487
Hypersonic wind tunnels - Gas flow
2320
Hypersonic wind tunnels - Operation
2483
Hypervelocity projectiles - Impact
2827, 2828
Hypervelocity projectiles - Penetration
2825, 2830, 2831
Hypervelocity vehicles - Test methods
107
Hypnotic experiences - Test methods
1567

Subject Index

Hypothalamic stimulation - Physiological effects
1571
Hypothalamus - Hormonal influence
2093, 2101
Hypothalamus - Lesions
2092, 2094
Hypothalamus - Luteinizing hormone secretion
2096
Hypothalamus - Luteotrophic secretion
2092
Hypoxia - Brain tissue
1575
Hypoxia (Rat) - Biochemical effects
1656
Hypoxia (Rat) - Pathological effects
1656, 1657
Hysteresis - Compositional transitions
2286

Ice - Free radicals
13-15
Ice - Hydroxyl radicals
11
Ice - Molecular structure
1094
Ice - Paramagnetic resonance
13-15
Ignition - Analysis
2207-2209
Ignition - Heat transfer
2824
Ignition systems - Development
309
Impact shock - Physical effects
1035, 1036, 2831
Impact shock - Test methods
2825, 2827, 2828
Impedance - Converter
909, 915
Impedance - Mathematical analysis
908, 915
Incoherent scattering - Measurement
2891
Incompressible flow - Mathematical analysis
201, 202, 575, 593
Incompressible fluids - Mathematical analysis
2184
Indexes - Preparation
2030
Indium - Electrical properties
1597
Indium antimonide - Electrochemical properties
1751
Indium antimonide - Mechanical properties
1751, 1753
Indium antimonide crystals - Anisotropy
88
Indium antimonide crystals - Electromagnetic properties
86, 87, 89, 90
Indium antimonide crystals - Growth
720
Indium antimonide crystals - Hall effect
86, 89, 90
Indium antimonide crystals - Magnetoresistance
86, 90
Indium ions - Hydrolysis
2431
Indium isotopes (Radioactive) - Electron scattering
2584
Individual behavior - Analysis
1797
Indoles - Oxidation-reduction reactions
1988
Industrial engineering - Sociological analysis
978
Industrial psychology - Applications
978
Industrial relations - Israel
978
Inelastic scattering - Differential cross section
2448-2450
Inelastic scattering - Mathematical analysis
777, 2270
Inelastic scattering - Quantum mechanics
699
Information - Data processing systems
2027
Information retrieval - Analysis
2968
Information retrieval - Classifications
2968
Information retrieval - Coding
2967, 2968, 2971
Information retrieval - Crystallographic data
2028-2053, 2056
Information retrieval systems - Design
2967
Information retrieval systems - Reliability
2973
Information retrieval systems - Statistical analysis
2973
Information retrieval systems - Theory
2970
Information theory
1020, 1420, 1429, 1460, 1462, 1476, 1793, 2967-2970, 2972, 2974
Information theory - Mathematical analysis
365, 2672
Information theory - Sampling
2407
Information theory - Statistical analysis
1427, 1428, 2633
Infrared spectra - Analysis
532, 1057, 1584, 1600, 1601
Infrared spectroscopy - Applications
1060, 2901-2903
Insects - Dark adaptation
1072
Instrumentation - Electrical properties
554
Integral equations
see also separate Mathematical Subject Classification, p. 903
Integral equations - Applications
1460, 1785, 1811
Interferometers - Applications
1057-1062, 2702

Interferometers - Design
2610
Interferometers - Sensitivity
2614, 2619
Interferometry - Applications
2246, 2486
Intermetallic compounds - Electrical properties
554
Intermetallic compounds - Physical properties
1751, 1753
Internal ballistics - Erosive burning
690
Interplanetary dynamics - Mathematical analysis
1228
Interplanetary gas - Cosmic rays
1228
Interplanetary matter - Astrophysics
1763
Interplanetary travel - Navigation
340
Interracial groups— Communications
2757
Interstellar gas - Properties
2451
Interstellar matter - Theory
218
Intestines (Cow) - Intracellular dopamine
1126
Iodine - Addition reactions
1951, 1952
Iodine - Recombination reactions
926
Iodine isotopes (Radioactive) - Chromatographic analysis
101, 102
Iodine isotopes (Radioactive) - Organic binding
99, 100, 102
Iodine isotopes (Radioactive) - Test methods
1894
Iodine vapor - Electron scattering
1909
Ion and Plasma Propulsion - Symposium
2354
Ion beams - Applications
1578
Ion beams - Energy
2956
Ion beams - Spectrographic analysis
2765, 2951
Ion beams - Thrust
1831, 1832
Ion density - Determination
3017
Ion gages - Power supply
2978
Ion-molecule reactions - Mass spectra
729, 734
Ion rockets - Design
1833
Ion rockets - Plasma source
71
Ion rockets - Research
1833
Ionic crystals - Dislocations
1849
Ionic crystals - Electron mobility
2393
Ionic crystals - Mathematical analysis
323
Ionic crystals - Plasticity
1849
Ionic crystals - Radiation effects
2024
Ionic crystals - Test methods
2024, 2025
Ionization - Mathematical analysis
2783, 3011
Ionization - Theory
2784
Ionization chambers - Design
721, 1831
Ionization chambers - Performance
1832
Ionization gages - Applications
1528
Ionization gages - Calibration
1528
Ionization potentials - Mathematical analysis
1369
Ionizing radiation - Applications
568
Ionosphere - Blunt bodies
2161
Ionosphere - Conductivity
1181
Ionosphere - E-layer
2272
Ionosphere - Electron density
1351
Ionosphere - Flight simulation
2160
Ionosphere - Magnetic fields
1181
Ionosphere - Radio waves
1532
Ionosphere models - Turbulence
507
Ionospheric propagation - Mathematical analysis
2623
Ionospheric propagation - Theory
2623, 2624, 2627
Ions - Chemical properties
349, 350
Ions - Density
1484, 2894
Ions - Diffusion
730, 2979
Ions - Energy
419, 2855
Ions - Hyperfine structure
1715
Ions - Impact theory
2825, 3012
Ions - Motion
2873
Ions - Resonance
2513, 2517
Ions - Spectra
803-815, 1351, 2527, 2990

Subject Index

Ions - Statistical mechanics
2874
Ions - Thermodynamics
1991
Iridium compounds - Chemical reactions
1649
Iridium compounds - Substitution reactions
1651
Iridium isotopes (Radioactive) - Decay
2820
Iron - Ablation
2945
Iron - Aging
1897, 1905
Iron - Crystal lattice
819
Iron - Diffusion
2249
Iron - Dislocation motion
983
Iron - Internal friction
1898
Iron - Magnetic properties
980, 982-985
Iron - Spectrographic analysis
803, 806, 807
Iron - Spectrophotometric analysis
865
Iron - Thermodynamic properties
984
Iron alloys - Heat content
330
Iron alloys - Magnetic properties
979, 986
Iron alloys - Phase studies
876
Iron alloys - Structure analysis
979
Iron carbide - Phase transitions
2796
Iron castings - Stresses
1897
Iron-chromium alloys - Oxidation
399, 2250
Iron compounds - Absorption spectrum
819
Iron compounds - Crystal structure
2797, 2798
Iron compounds - Semiconductivity
1347
Iron isotopes - Applications
862
Iron isotopes - Energy levels
1395, 2813
Iron isotopes - Mössbauer effect
885
Iron isotopes - Neutron threshold
670
Iron isotopes - Phase transitions
1395
Iron isotopes - Resonance absorption
883
Iron isotopes - Spectra
2813
Iron isotopes - Zeeman effect
883
Iron isotopes (Radioactive) - Nuclear magnetic resonance
746
Iron-nickel alloys - Properties
2252
Iron oxides - Conductivity
1349
Iron oxides - Magnetic properties
1675, 1676
Iron particles - Acceleration
2766
Irreversible processes - Quantum mechanics
693, 695, 698
Irreversible processes - Statistical mechanics
183, 689
Irreversible processes - Thermodynamic properties
1330
Isoamyl bromide - Dielectric relaxation
185
Isocitratase - Enzymatic properties
1976
Isocitratase - Photosynthesis
1978
Isomerism - Properties
1884
Isomers - Reactions
1882
Isopropyl alcohols - Dehydrogenation
959
Isopropyl radicals - Electronegativity
506
Isotopes
see also specific isotopes, e.g., Carbon isotopes
Isotopes - Atomic beams
270
Isotopes - Bombardment
1379
Isotopes - Energy levels
1376
Isotopes - Photoneutron threshold
2082
Isotopes - Spectra
1407, 1537
Isotopes - Transition energy
2812
Isotopes (Radioactive)
see also Radioisotopes
see also specific isotopes, e.g., Thallium Isotopes (Radioactive)
Isotopes (Radioactive) - Atomic beams
269, 271-273
Isotopes (Radioactive) - Decay
1595, 1827
Isotopes (Radioactive) - Dose rate
1066
Isotopes (Radioactive) - Electron transitions
63-65
Isotopes (Radioactive) - Hyperfine structure
272-274
Isotopes (Radioactive) - Nuclear spin
269, 271, 272
Isotopic reactions - Mathematical analysis
347

Isotopic reactions - Molecular volume effects
347, 349

Jet engine noise - Analysis
2770, 2776
Jet mixing flow - Analysis
2325, 2768
Jet mixing flow - Interactions
2196
Jet mixing flow - Mathematical analysis
2143, 2327
Jet mixing flow - Properties
2328
Jet mixing flow - Theory
2326
Jet plane noise - Analysis
1518, 2771
Jets - Deflections
644
Journal bearings - Stability
688
Journal bearings - Theory
687, 688

Ketones
see also specific compounds, e.g., Acetone; Benzophenone
Ketones - Crystal structure
754
Ketones - Phosphorescence
2399
Ketones - Photolysis
2399
Ketones - Spectra
1187, 2985, 2986
Ketones - Stereochemistry
2986
Kinematics - Mathematical analysis
2609
Kinetic theory - Mathematical analysis
140
Kinetic theory - Quantum mechanics
183
Kinetic theory - Statistical analysis
2595
Klystrons - Analysis
2604
Klystrons - Design
2175
Klystrons - Noise properties
1834
Klystrons - Performance
2604

Laboratory procedures - Applications
1837, 2285
Lactation - Hormonal influence
2097
Laminar boundary layer - Electrical factors
80
Laminar boundary layer - Heat transfer
1419, 2156, 2216
Laminar boundary layer - Mathematical analysis
56, 80, 416, 585, 1413, 1414, 1692, 1693, 1695, 2217, 2324, 2568, 2729
Laminar boundary layer - Separation
2781
Laminar boundary layer - Shock waves
1337
Laminar boundary layer - Stability
1694, 2780
Laminar boundary layer - Supersonic flow
2780, 2782
Laminar boundary layer - Theory
2139, 2144
Laminar flames - Radical distribution
961
Laminar flames - Theory
960, 961
Laminar flow - Heat transfer
592
Laminar flow - Interface velocity
2330
Laminar flow - Porous materials
2158
Laminar mixing - Mathematical analysis
1738, 1739
Language - Analysis
1429, 1635, 1636, 1638, 1775
Language - Coding
1637, 1474, 1483, 1485, 1522-1525
Language - Grammar analysis
1445, 1473
Language - Mathematical analysis
1473-1476, 3047
Language - Speech analysis
1451, 1467
Lanthanum compounds - Conductivity
1347
Lanthanum isotopes - Nuclear spin
271
Lasers - Bibliography
2703
Lasers - Mathematical analysis
2702
Lasers - Research
2703
Lasers - Theory
2702
Lattice imperfections - Thermodynamic properties
1212
Lattices - Thermal vibrations
862
Lead - Cyclotron resonance
279
Lead - Electron scattering
2574
Lead - Stress analysis
1109
Lead compounds - Properties
788
Lead ions - Hydrolysis
2426, 2427
Lead oxide - Neutron diffraction
2070

Subject Index

Lead-selenium vapors - Mass spectra
556
Lead-selenium vapors - Stability
556
Lead-tellurium vapors - Mass spectra
556
Lead-tellurium vapors - Stability
556
Learning - Analysis
1454
Learning - Injury effects
1965
Learning - Physiological factors
2418
Learning - Reaction (Psychology)
59
Learning - Selection
1629-1632
Learning - Training devices
57, 58
Learning processes - Habituation
950
Learning processes - Test methods
1629-1632
Least squares method
see also separate Mathematical Subject Classification, p. 903
Least squares method - Correlation
344
Lenses - Quadrupole system
1404
Lesions - Learning impairments
1965
Lesions - Luteotrophic secretion
2092
Lesions - Physiological changes
2790
Lesions - Psychological factors
391, 1776
Lesions - Reproductive changes
2789
Lesions - Spinal cord sections
2975
Lesions - Surgical methods
2793
Lesions - Vascular changes
2788
Lesions (Brain) - Sex impairment
1966
Lesions (Frog) - Physiological effects
1661
Libraries - Documentation cooperation
3046
Lift - Pressure
1093
Lift - Subsonic flow
1093
Light - Diffraction analysis
2835
Light - Microwave modulation
744
Light - Polarization
2409, 2834
Light - Propagation
1225
Light - Scattering
2204, 2205
Light - Spectrographic analysis
2411
Light - Transmission
1536
Light flashes - Rhythmic variations
2225
Light pulses - Physical properties
2571, 2703
Light sensitivity - Experimentation
2994, 2996, 2997
Light source - Design
2571
Light stimulation (Cat) - Perception
2113, 2114, 2116
Limiters - Noise
1466
Line spectrum - Analysis
3012
Line spectrum - Broadening
2538, 3016
Line spectrum - Cluster method
3011
Line spectrum - Doppler effects
3013, 3018, 3020
Line spectrum - Foreign gas effects
3018
Line spectrum - Intensity
3027
Line spectrum - Shifts
3014
Line spectrum - Statistical analysis
3010
Line spectrum - Theory
3020
Linear accelerators - Applications
2586
Linear systems - Identification
860, 861
Linguomandibular reflex - Carbon dioxide sensitivity
1077
Liquid gases - Physical properties
1195, 2907
Liquid Propellant Rocket Combustion - Symposium
2309
Liquid rocket propellants
see also Rocket propellants
Liquid rocket propellants - Combustion
19, 103, 962, 963, 1830, 2164, 2662, 2663
Liquids
see also Fluids
Liquids - Dielectric properties
2246
Liquids - Evaporation
24, 2201
Liquids - Laminar flow
2707
Liquids - Magnetic relaxation
1598
Liquids - Molecular structure
2245, 2246

Liquids - Spectra
2751
Liquids - Surface properties
2201
Liquids - Surface tension
2196
Liquids - Thermodynamics
420, 2741
Liquids - Viscosity
1317
Lithium - Ionization
732
Lithium - Proton cross sections
732
Lithium-aluminum fluorides - Mass spectra
555, 557
Lithium borohydrides - Reaction kinetics
474
Lithium compounds - Chemical reactions
1081
Lithium compounds - Crystal structure
2057
Lithium crystals - X-ray analysis
2057
Lithium fluoride (Radioactive) - Defect clusters
845
Lithium fluoride crystals - Conductivity
878
Lithium fluoride crystals - Diffusion
878
Lithium fluoride crystals - X-ray diffraction analysis
845
Lithium halides - Mass spectra
557
Lithium hydride - Electronic structure
930
Lithium hydride - Infrared spectra
1600, 1601
Lithium hydride - Isotopic impurities
1601
Lithium hydroxide - Crystal structure
1326
Lithium hydroxide crystals - Infrared spectra
1584
Lithium isotopes - Angular distribution
1365
Lithium isotopes - Atomic energy levels
655, 657
Lithium isotopes - Bombardment
660
Lithium isotopes - Disintegration
3024
Lithium isotopes - Phase transitions
3024
Lithium sulfate monohydrate - Magnetic resonance
1082
Liver - Hypoxia effects
1656, 1657
Load distribution - Mathematical analysis
1332
Loudspeakers - Design
1432
Low energy physics - Neutrinos
2305
Low Pressure Aerodynamics - Symposium
2779
Low temperature research
769, 1504, 1557, 1726, 2535, 2536, 2683, 2684, 2752, 3021
Lubricants - Laboratory applications
2285
Lubricants - Properties
2285
Luminescence - Bibliography
94, 95
Luminescence - Measurement
232, 1938
Luminescence - Pressure effects
838, 840
Luteinizing hormone - Estrogen regulation
2099
Luteinizing hormone - Hypothalamic influence
2096, 2098
Luteinizing hormone - Lactation effects
2097
Luteinizing hormone - Neural regulation
2101
Luteinizing hormone - Regulation
2100
Lutetium isotopes - Magnetic resonance
269
Lystine - Metabolic pathways
1976

Machine translation - Characteristics
370
Machine translation - Development
3047
Machine translation - Theory
1476
McLeod gauge - Semi-automatic operation
2480
Magnesium - Elastic scattering
2447
Magnesium crystals - Fermi surface
402, 403
Magnesium crystals - Oscillations
402, 403
Magnesium films - Grain structure
567
Magnesium oxide - Spectrographic analysis
1702
Magnesium oxide crystals - Ductility
325, 326
Magnesium oxide crystals - Fracture
321, 327
Magnesium oxide crystals - Impurities
1715
Magnesium oxide crystals - Paramagnetic resonance
806
Magnesium oxide crystals - Spectrographic analysis
1714-1716, 2497
Magnesium titanates - Thermoelectric properties
873
Magnetic fields - Analysis
1958, 1959

Subject Index

Magnetic fields - Applications
1225, 1316, 1437, 1447, 1482, 1754, 1770, 2131, 2133, 2478, 2485, 3029
Magnetic fields - Boundary conditions
2331
Magnetic fields - Boundary layer
80, 1315
Magnetic fields - Determination
1101
Magnetic fields - Electrical effects
86, 90, 1381, 1553, 2327
Magnetic fields - Hydromagnetic wave effects
454
Magnetic fields - Physical effects
984
Magnetic fields - Properties
1101
Magnetic fields - Resistors
2636
Magnetic fields - Shock effects
1263
Magnetic fields - Symmetry
1102
Magnetic materials - Magnetic viscosity
984
Magnetic materials - Properties
1674
Magnetic materials - Torque
1350
Magnetic pinch - Detonation
2351
Magnetic pinch - Deuterons
1241
Magnetic pinch - Electrode properties
2358, 2360
Magnetic pinch - Mathematical analysis
2357
Magnetic pinch - Propulsion
2353
Magnetic pinch - Stability
1878
Magnetic properties - Spin polarization
1410
Magnetic resonance - Magnetic factors
2911, 2912
Magnetic resonance - Mathematical analysis
1545
Magnetic resonance - Measurement
743, 2528, 2535, 2536
Magnetic resonance - Proton separation
1083-1086
Magnetic storms - Forbush decrease
2459
Magnetic storms - Measurement
2459
Magnetic storms - Solar magnetic factors
2458
Magnetic storms - Theory
1221, 2458
Magnetic undulators - Performance
1996
Magnetic viscosity - Temperature factors
983
Magnetic viscosity - Theory
979, 985, 986
Magnetite - Electrical properties
1349
Magnetite - Ferrimagnetic resonance
1675
Magnetite - Magnetic properties
1676
Magnetite - Substitution reactions
2252
Magnetite electrodes - Electrochemistry
1654
Magnetoaerodynamics - Compressible flow
581
Magnetoaerodynamics - Mathematical analysis
590, 594
Magneto-fluid Dynamics - Symposium
1758
Magnetohydrodynamic channels - Current loop effects
716, 717
Magnetohydrodynamic channels - Velocity profile
716, 717
Magnetohydrodynamic waves - Mathematical analysis
2184
Magnetohydrodynamic waves - Structure
77
Magnetohydrodynamic waves - Theory
1956
Magnetohydrodynamics - Energy converters
2356
Magnetohydrodynamics - Gas ionization
2161
Magnetohydrodynamics - Magnetic fields
583
Magnetohydrodynamics - Mathematical analysis
81, 83, 454, 1103, 2011, 2131, 2353, 2484, 2487, 2727, 2728
Magnetohydrodynamics - Particle motion
1103
Magnetohydrodynamics - Pinch properties
2357
Magnetohydrodynamics - Rotational flow
2131
Magnetohydrodynamics - Theory
75, 583, 1878, 1879, 2326, 2651
Magnetometers - Applications
1342
Magnetometers - Design
1350
Magnetrons - Design
2175
Malate synthetase - Enzymatic properties
1977
Manganese - Neutron cross sections
2853
Manganese - Spectrographic analysis
808
Manganese alloys - Heat content
330
Manganese chloride - Chemical reactions
1940
Manganese compounds - Crystal structure
2797, 2798

Manganese crystals - Paramagnetic resonance
805
Manganese ions - Electron spin resonance
1643
Manganese ions - Magnetic resonance
748
Manganese ions - Mathematical analysis
1327, 1329
Manganese ions - Paramagnetic resonance
808, 1644, 1645
Manganese isotopes (Radioactive) - Beta decay
1391
Manganese isotopes (Radioactive) - Gamma rays
1391
Manganous oxide - Dissociation
2248
Manganous oxide - Ionization
2248
Manometers - Design
2480
Martensite - Crystal structure
876
Maser oscillators - Mathematical analysis
297
Maser oscillators - Paramagnetic resonance
297
Masers - Amplitude modulation
292
Masers - Applications
485, 486, 510
Masers - Materials
1639
Masers - Mathematical analysis
483
Masers - Operating properties
1452, 1498
Masers - Solid state
1498
Mass spectroscopy - Applications
1138, 1139, 2494, 2873
Mass spectroscopy - Instrumentation
1138, 1139, 1141
Mass transfer cooling - Heat transfer
1692, 1693
Materials - Deformation
2709
Materials - Electrical properties
1820
Materials (Crystalline) - Stress-strain relation
602
Mathematical computers
see also Analog computers; Digital computers
Mathematical computers - Design
2170
Mathematical functions
see also separate Mathematical Subject Classification, p. 903
Mathematical functions - Tables
2936
Mathematical models - Applications
1614
Mathematical models - Theory
1771
Mathematical Statistics - Symposium
250
Matrix elements - Particle decay
2254
Median eminence - Hormonal control
2100
Medical equipment - Design
1658, 1731, 1733, 1734
Melanin - Resonance
2515
Membranes - Electrical potential
2823
Membranes - Frequency
1246, 1248
Membranes - Inequalities
1246, 1248
Memory - Psychophysical factors
1616
Memory - Test methods
1629-1632, 2862-2864
Memory devices - Design
2649
Memory devices - Mathematical analysis
365
Memory processes - Theory
1616
Mental therapy - Applications
192
Mercuric halides - Thermodynamics
2335
Mercuric iodides - Chemical reactions
1717, 1720, 1721
Mercuric iodides - Infrared spectra
1719
Mercuric iodides - Thermodynamic properties
1717
Mercuric oxide - Solubility
2430
Mercuric oxide - Vibrational frequency
1719
Mercury (Vapor) - Electrical properties
710
Mercury (Vapor) - Thermodynamics
710
Mercury isotopes - Hyperfine structure
490, 1426, 1480, 1481, 1548
Mercury isotopes - Magnetic resonance
490
Mercury isotopes - Nuclear resonance
1482
Mercury isotopes (Radioactive) - Hyperfine structure
1480, 1481, 1535, 1539
Mercury isotopes (Radioactive) - Nuclear resonance
1482
Mesityl groups - Isomerism
2293
Meson beams - Applications
1050, 1054
Meson capture - Analysis
1195, 1196, 1200, 2841
Meson capture - Theory
254, 455, 456, 458
Meson exchange - Dispersion theory
2256

Subject Index

Meson scattering - Emulsions
2822
Mesons - Annihilation reactions
2008
Mesons - Decay
387, 455, 457, 458, 1043, 1045, 1189, 1194, 1220, 1386, 2254, 2880
Mesons - Depolarization
3031
Mesons - Dispersion relations
256
Mesons - Electromagnetic properties
2541
Mesons - Electronic transitions
254
Mesons - Electroproduction
2304
Mesons - Energy
2842
Mesons - Energy factors
2664
Mesons - Energy thresholds
256
Mesons - Exchange reactions
1195, 2838
Mesons - Field theory
264
Mesons - Furry theorem
2302
Mesons - Interactions
2406
Mesons - Magnetic moments
2557
Mesons - Mass difference
255, 264
Mesons - Mathematical analysis
253
Mesons - Nuclear cross sections
1220
Mesons - Nuclear properties
1043
Mesons - Nuclear reactions
258, 1053, 1189, 1190, 1192, 1590, 1591, 2560, 2700, 2840
Mesons - Parity
2700
Mesons - Photoproduction
2572, 2588
Mesons - Polarization
2696, 3029, 3030
Mesons - Production
387, 1386, 2547, 2561, 2664
Mesons - Reactions
2298
Mesons - Resonance
260, 267, 2547
Mesons - Scattering
142, 253, 255, 257, 258, 393, 1382, 2256, 2301, 2552, 2572, 2693, 2696, 2822
Mesons - Spectra
2255
Mesons - Structure parameters
267
Mesons - Theory
257, 2842, 3026
Metabolism - Dicarboxylic acid cycle
1979
Metabolism - Oxoglutarate oxidation
1981
Metabolism - Two-carbon compounds
1972
Metal acetates - Radiolysis
837
Metal ammonia solutions - Electron spin
2889
Metal carbonyls - Synthesis
792
Metal films - Cathodoluminescence
1440
Metal films - Electron microscopy
686
Metal films - Grain structure
567
Metal films - Phase transformation
399
Metal films - Preparation
636
Metal fluoride complexes - Conductance
48
Metal fluoride complexes - Cryoscopic determination
48
Metal fluorides - Electronic structures
470
Metal halide crystals - Production
1352
Metal halides
see also Alkali halides
Metal halides - Electric potential
927
Metal hydrides - Electronic structures
470
Metal hydrides - Magnetic properties
2445
Metal ions - Energy
1328
Metal ions - Hydrolysis
2426, 2427, 2430, 2431
Metal ions - Spectrographic analysis
809
Metal ions - Volumetric analysis
1841
Metal nitrites - Spectra
2284
Metal oxidation - Reviews
1142
Metal oxides - Kinetic theory
1143
Metal plates - Mathematical analysis
539, 540
Metal plates - Thermal stresses
704
Metal seals - Preparation
2632
Metal spheres - Preparation
2948
Metal surfaces - Catalytic properties
2203

Metal surfaces - Ionic emission
572
Metallic compounds - Thermodynamic properties
1911
Metallic crystals - Color centers
987
Metallic crystals - Crystal structure
2497, 2799
Metallic crystals - Electrochemistry
2135
Metallic crystals - Internal friction
870
Metallic crystals - Ion microscopy
2021
Metallic crystals - Lattice defects
462
Metallic crystals - Microphotographic analysis
681, 683
Metallic crystals - Phase transitions
1345
Metallic crystals - Physical effects
130
Metallic crystals - Plasticity
354
Metallic crystals - Stresses
352-354, 1899, 2080
Metallic crystals - Structure
682, 683
Metallic crystals - Surface properties
741, 992, 2135
Metallic crystals - X-ray analysis
2140
Metallic oxides - Thermodynamics
1912
Metallic surfaces - Oxygen reactions
316
Metallic surfaces - Secondary emission
595
Metallic surfaces - Sulfuration
957
Metallic vapors - Stability
556
Metalorganic compounds - Chemical bonds
2804
Metalorganic compounds - Chemical reactions
1650, 1717, 1718, 1720, 1721, 1724, 1778
Metalorganic compounds - Conductivity
841
Metalorganic compounds - Heats of formation
1081
Metalorganic compounds - Infrared spectra
791, 1719
Metalorganic compounds - Molecular structure
193
Metalorganic compounds - Properties
787, 788
Metalorganic compounds - Stereochemistry
400, 401
Metalorganic compounds - Synthesis
787-790, 792, 841, 1650
Metalorganic compounds - Thermodynamic properties
193, 195, 196, 1717
Metalorganic compounds - Vibrational frequency
1719
Metals
see also specific metal, e.g., Aluminum
Metals - Ablation
2945
Metals - Atmospheric data
2401
Metals - Coatings
1749
Metals - Crystal structure
872
Metals - Cyclotron resonance
279
Metals - Deformation
872
Metals - Diffusion
459, 461, 869, 870, 872, 2251, 2253
Metals - Electrical properties
1218
Metals - Fermi surface
167, 168, 713
Metals - Friction
2338
Metals - Liquid droplets
2948
Metals - Optical properties
459
Metals - Oxidation
1142, 1143, 2251
Metals - Phase studies
870
Metals - Purification
678, 683
Metals - Quenching
462
Metals - Specific heat
329
Metals - Stress analysis
376, 1109, 1608
Metals - Surface properties
571, 1748, 1749
Metals - Thermal vibrations
67
Metals - Ultrasonic analysis
162-168
Metals - Vaporization
2830
Metals - Zone melting
678, 679, 683
Meteorological forecasting - Mathematical analysis
541
Methane - Adsorption
2909
Methane - Inhibitory properties
822
Methane - Sound dispersion
969
Methane - Vibrational excitation
969
Methane - Vibrational transitions
965
Methyl amine reactions - Kinetics
650
Methyl amine reactions - Nuclear magnetic resonance
650

Subject Index

Methyl halides - Spectrographic analysis
1585
Methyl radicals - Electronegativity
506
Methylnioxime - Chelating agent
45, 46
Methylpyrrole - Infrared spectra
193
Mica - Crystal structure
987
Mica - Surface properties
569
Mica sheets - Ultraviolet retardation plates
498
Microorganisms - Biosynthesis
1984
Microorganisms - Chemical effects
2731
Microorganisms - Circadian rhythms
2226
Microorganisms - Growth
1974
Microorganisms - Metabolism
1972
Microorganisms - Photosynthesis
1978
Microparticles - Acceleration
2766
Microphotographic equipment - Design
681
Microscopy (Ion) - Applications
2022-2026
Microscopy (Ion) - Capabilities
2021
Microscopy (Ion) - Performance
2022
Microwave amplifiers
see also specific types of microwave amplifiers, e.g., Masers
Microwave amplifiers - Design
2175, 2477, 2616
Microwave amplifiers - Masers
630
Microwave amplifiers - Materials
1639
Microwave amplifiers - Operation
1498, 1917
Microwave amplifiers - Signal-to-noise ratio
1821
Microwave equipment - Antennas
2610
Microwave equipment - Design
2467, 2468
Microwave equipment - Electron tubes
1916, 1917, 2607
Microwave equipment - Instrumentation
1182, 2610
Microwave frequency - Measurement
1550
Microwave generators - Design
1996
Microwave generators - Masers
630
Microwave generators - Properties
1994
Microwave multipliers - Design
906
Microwave oscillators - Design
298, 2175
Microwave oscillators - Operation
1917, 2599
Microwave oscillators - Spin
296
Microwave oscillators - Theory
292
Microwave radiation - Measurement
1546, 1549
Microwave radiation - Propagation
1558
Microwave resonators - Rutile
511-513
Microwave separators - Design
2587
Microwave separators - Instrumentation
2587
Microwave spectroscopy - Applications
1995, 2533
Microwave spectroscopy - Bibliography
634
Microwave spectroscopy - Equipment
128
Microwave spectroscopy - Instrumentation
1821
Microwave spectroscopy - Maser techniques
1821
Microwaves - Applications
2177
Microwaves - Cerenkov radiation
482
Microwaves - Energy transfer
705
Microwaves - Interferometry
2246
Microwaves - Mathematical analysis
2603, 2608
Microwaves - Physical factors
1770
Microwaves - Production
2175
Microwaves - Transmission
2468
Millimeter-wave generators - Design
1996, 2175
Millimeter-wave generators - Properties
1994
Millimeter-wave generators - Review
2175
Millimeter-wave spectra - Centrifugal effects
626
Millimeter-wave spectra - Stark effects
628
Millimeter-wave spectroscopy - Design
636
Millimeter waves - Applications
2469
Millimeter waves - Detection
128, 636

Millimeter waves - Measurement
636, 905
Millimeter waves - Production
128, 482, 905
Millimeter Waves - Symposium
2180
Millimeter waves - Transmission
1992
Minerals - Crystal structure
1344
Models (Simulation) - Flight test
2160
Models (Simulation) - Star properties
2452
Molecular association - Analysis
1696
Molecular association - Theory
2805, 2806
Molecular beams - Ammonia gas
1452
Molecular beams - Applications
316, 320
Molecular beams - Detection
1556
Molecular beams - Organic molecules
485
Molecular beams - Production
484, 1578
Molecular beams - Sodium compounds
1457
Molecular beams - Sourcss
484
Molecular beams - Thermodynamics
1564
Molecular beams - Velocity
491, 494
Molecular collisions - Lifstimes
965, 967
Molecular flow - Hsat transfsr
1339
Molecular flow - Oscillation
1338
Molecular radiation - Shock wavs sffscts
76
Molecular rotation - Magnetic effects
961
Molecular rotation - Mathematical analysis
638, 1457
Molecular rotation - Organic halides
1922
Molecular rotation - Quantum mechanics
1211
Molecular rotation - Spectra
1057, 1058, 1061
Molecular scattering - Measurement
312
Molecular spectra - Intensity
2964
Molecular spsctra - Mathematical analysis
2949
Molecular spsctra - Measurement
2950
Molecular spectra - Temperature factors
2963
Molecular spectra - Ultra-violet analysis
2955
Molecular spectra - Vibrational analysis
2955
Molecular spectroscopy - Analysis
1438
Molecular spectroscopy - Applications
1613, 2899, 2902, 2903
Molecular spectroscopy - Mathematical analysis
1058-1061, 2959
Molecular structure - Analysis
2120, 2794
Molecular structure - Atomic orbitals
1107, 1108
Molecular structurs - Chemical effects
2859
Molecular structurs - Correlations
533
Molecular structure - Diffraction analysis
1907, 1908, 1951-1953, 1955
Molecular structurs - Digital computers
463-470
Molscular structure - Environmental influencs
2391
Molscular structure - Spectra
1908, 2284
Molecular structure - X-ray diffraction analysis
1592, 1710-1712
Molecules
see also specific types of molecules, e.g., Hydrogsn molecules
Molecules - Dipole moments
1351
Molecules - Electrical properties
1543
Molscules - Electron transitions
1583, 2949, 2950, 2953, 2955, 2961
Molecules - Electronic states
2947
Molecules - Ensrgy
2136-2138, 2946, 2953
Molecules - Excitation ensrgy
2397
Molecules - Ionization potentials
1022
Molscules - Magnetic moments
1237
Moleculss - Motion
2433, 2436, 2490
Molecules - Nuclear ensrgy levels
661
Molsculss - Phass transitions
2959
Molscules - Quadrupole momsnts
640
Molecules - Quantum mechanics
1237
Molecules - Radiation
76
Molecules - Rsaction kinetics
558
Molecules - Rotational energy
638, 2956

Subject Index

Molecules - Spectrographic analysis
1058, 1061, 1063, 2964
Molecules - Substitution reactions
1022
Molecules - Vibration
1144-1146, 1148, 1583, 2949
Molecules - Vibrational energy
2247
Molecules - Vibrational excitation
205
Molecules - Vibrational relaxation
2202
Molecules (Ionic) - Vibration
726
Molybdenum - Atomic spectra
63, 65
Molybdenum - Electron transition
65
Molybdenum atoms - Crystal structure
2810
Molybdenum compounds - Crystal structure
1356
Monamine oxidase - Dopamine inactivation
1125
Monatomic lattices - Mathematical analysis
1234
Monochromatic light - Detection
1561
Monochromatic light - Focusing
2816, 2817
Monochromatic light - Intensity
2835
Monochromators - Applications
2816, 2817
Motion - Mathematical analysis
275, 2262, 2269
Motoneurone - Properties
1172
Motor reactions - Analysis
2463
Motor reactions - Test methods
1172, 2661
Mucopolysaccarides - Metabolism
1110
Mucopolysaccarides - Properties
1112
Mucosa - Physiological properties
333, 1071
Muonium - Formation
3033
Muonium - Hyperfine structure
3029
Muonium - Theory
3026
Muons - Beta decay
2298
Muons - Depolarization
3031, 3033
Muons - Properties
3032
Muons - Pseudoscaler coupling
2254
Muons - Reactions
3029
Muscle fibers - Discharge frequency
1659, 1660
Muscle fibers - Physiological properties
1660
Muscle spindles - Properties
1172
Muscles - Electrical properties
1121
Muscles - Isometric contraction
1660
Muscles - Motor reactions
1173
Muscles - Sensitivity
1118-1120
Muscles - Tension
1659
Myoneural junction - Subthreshold properties
1121
Mytilus - Biosynthesis
1987, 1988

Naphthalene - Molecular structure
1907
Naphthalene - Spectra
2527, 2963
Naphthalene ions - Hyperfine coupling
2896
Naphthalene ions - Spectra
2896
Naphthylamine molecules - Heat transfer
2247
Nasal mucosa - Electrical stimulation
1071
National defense - Strategy
1906
Neon - Gyromagnetic properties
3034
Neon - Ionization
1680
Neon - Magnetic moments
3026
Neon - Microwave radiation
1546
Neon - Nuclear energy levels
2446
Neon (Solid) - Impurities
2414
Neon isotopes - Energy levels
1392
Neon molecules - Orbital functions
471
Nerve cells - Color stimulation
793
Nerve cells - Discharge frequency
1659, 1660
Nerve cells - Electrical properties
1492, 1513
Nerve cells - Firing patterns
1527
Nerve cells - Hypoxia effects
1575
Nerve cells - Morphology
1742

Nerve cells - Nociceptive stimulation
1073
Nerve cells - Properties
1513
Nerve cells - Tactile stimulation
1073
Nerve cells - Transmission
1513
Nerve end organs - Desensitization
1117
Nerve end organs - Physiological properties
1117
Nerve pathways - Properties
1073
Nerve stimulation - Physiological properties
1117
Nerve transmission - Computer analysis
1492
Nerve transmission - Inhibition
1120
Nerves - Electrical potential
2823
Nerves - Motor reactions
1154, 1158, 1159, 1162, 1164, 1168, 1173
Nervous system
see also Central nervous system
Nervous system - Drug effects
621-623
Nervous systems - Electrical properties
951, 1018, 1171, 1479, 1531
Nervous system - Excitation
2823
Nervous system - Functional analysis
334, 1516
Nervous system - Gray matter
1745
Nervous system - Inhibition
645, 1016, 1017
Nervous system - Instrument simulation
334
Nervous system - Integrative capabilities
42
Nervous system - Mathematical analysis
425-427, 1744, 1745
Nervous system - Nerve cells
1742
Nervous system - Physiology
1285
Nervous system - Properties
1742
Nervous system - Responses
1458
Nervous system - Stimulation
1016-1018, 1285, 2464
Nervous system (Auditory) - Acoustic stimulation
1449
Nervous system (Auditory) - Cortical responses
440, 443, 1566
Nervous system (Auditory) - Electrical responses
1450, 1469
Nervous system (Auditory) - Physiology
129, 440, 441, 443
Nervous system (Auditory) - Responses
1449
Nervous system (Auditory) - Stimulation
821
Nervous system (Cat) - Acoustic factors
440-442
Nervous system (Cat) - Auditory stimulation
1450
Nervous system (Cat) - Cortical responses
1158, 1159, 1162, 1165, 1167-1169
Nervous system (Cat) - Drug effects
1566
Nervous system (Cat) - Electrical responses
1151, 1156, 1160, 1170
Nervous system (Cat) - Nerve cells
1435
Nervous system (Cat) - Physiology
1150, 1151, 1153, 1155-1157, 1160, 1163, 1164
Nervous system (Monkey) - Cortical responses
1154
Nervous system (Monkey) - Stimulation
2418
Nervous system (Rat) - Cortical responses
1776
Neuraminic acids - Physiological effects
2531
Neuristor - Applications
2641
Neuroelectric responses - Statistical analysis
1434
Neurology - Computer analysis
1454
Neuromuscular transmission - Mathematical analysis
427
Neuromuscular transmission - Properties
1172
Neuromuscular transmission - Test methods
1173
Neuronal networks - Computer analysis
1515
Neuronal networks - Equivalence theorems
1565
Neuronal networks - Mathematical analysis
1513, 1514, 1565
Neurophysiology - Computers
1282
Neurophysiology - Hormone effects
98
Neutrinos - Decay
1189, 2557
Neutrinos - Detection methods
2305
Neutrinos - Interactions
2300
Neutron bombardment - Physical effects
980, 982
Neutron cross sections - Measurement
2653
Neutron diffraction spectrometers - Design
1326
Neutron reactions - Analysis
2081
Neutrons - Angular distribution
1373
Neutrons - Annihilation reactions
2811

Subject Index

Neutrons - Binding energies
2085
Neutrons - Detection
270
Neutrons - Energy
2446
Neutrons - Energy spectra
2854
Neutrons - Exchange reactions
2838
Neutrons - Mathematical analysis
897
Neutrons - Measurements
1825
Neutrons - Nuclear reactions
2552, 2560
Neutrons - Polarization
2306, 2881
Neutrons - Production
2854
Neutrons - Scattering
1367, 1406, 2257, 2750
Neutrons - Structure analysis
2573, 2582
Nickel - Electron scattering
2574
Nickel - Electron spin resonance
1714
Nickel - Magnetic properties
980, 982
Nickel - Surface properties
2342
Nickel - Volumetric analysis
2176
Nickel catalysts - Effectiveness
1885
Nickel compounds - Crystal structure
2801
Nickel compounds - Exchange reactions
2288
Nickel crystals - Emissivity
424
Nickel ferrite - Diffusion properties
2252
Nickel ferrite - Magnetic properties
1342
Nickel ions - Electron density
1409
Nickel ions - Magnetic properties
1409
Nickel ions - Magnetic resonance spectra
748
Nickel ions - Spin resonance transitions
1716
Nickel isotopes - Nuclear moments
1714
Nickel oxides - Electrical properties
92
Nickel oxides - Physical properties
1345
Nickel-palladium alloys - Hall effect
393
Nickel-palladium alloys - Resistivity
393
Night-insects - Dark adaptation
1072
Niobium - Oxidation
1750
Niobium -Spectrophotometric analysis
45
Niobium-aluminum alloys - Crystal structure
375
Niobium-hydrogen systems - Thermodynamics
850
Nitric oxides - Decomposition
551, 553
Nitric oxides - Electron transitions
550, 552
Nitric oxides - Kinetics
551, 553
Nitric oxides - Quadruple moments
640
Nitric oxides - Ultraviolet spectra
550, 552
Nitriles - Alkylation
1915
Nitriles - Synthesis
1914
Nitritopentammine compounds - Chemical reactions
1884
Nitrogen - Absorption
712
Nitrogen - Afterglows
2910
Nitrogen - Chemical reactions
133
Nitrogen - Gas flow
2482
Nitrogen - Glow discharges
1999
Nitrogen - Molecular rotation
2956
Nitrogen - Nuclear reactions
2081
Nitrogen - Optical excitation
2957
Nitrogen atoms - Determination
10
Nitrogen atoms - Recombination reactions
2499
Nitrogen compounds - Decomposition
2952
Nitrogen compounds - Infrared spectra
2901, 2902
Nitrogen compounds - Radiation effects
1186
Nitrogen ions - Emission spectra
2772, 2774
Nitrogen ions - Stability
2874
Nitrogen isotopes - Electronic states
668
Nitrogen isotopes (Radioactive) - Alpha bombardment
1368
Nitroglycerin - Physiological properties
2417
Nitrous acid - Isomerization
234

Noise - Analysis
2770, 2776
Noise - Audiofrequencies
1834
Noise - Background discrimination
1509
Noise - Detection
1521
Noise - Mathematical analysis
1554
Noise - Measurement
1459, 1461
Noise - Pitch discrimination
1615
Noise - Reduction
1503
Noise - Spectra
1459
Noise (Control systems) - Mathematical analysis
858
Noise (Radar) - Mathematical analysis
858
Noise (Radio) - Measurement
2930
Noise (Radio) - Reduction
2637
Nomograms - Formation
1799
Non-crystalline Solids - Symposium
1762
Noradrenaline
see Norepinephrine
Norepinephrine - Adrenal medulla storage
1128
Norepinephrine - Brain metabolism
1131
Norepinephrine - Determination
1075
Norepinephrine - Physiological effects
645, 1074
Norepinephrine (Rabbit) - Brain storage
1129
Nose cones - Heat resistant surfaces
348, 349
Nozzles - Aerodynamic characteristics
107
Nozzles - Design
1418
Nozzles - Gas flow
2320
Nozzles - Operation
2465
Nozzles - Properties
2465
Nuclear attack - Group dynamics
832-834
Nuclear cross sections - Determination
2591
Nuclear cross sections - Inelastic scattering
777
Nuclear cross sections - Photoelectric effect
449
Nuclear cross sections - Potential parameters
782
Nuclear cross sections - Scattering
773
Nuclear emulsions
see also Photographic emulsions
Nuclear emulsions - Processing
2897
Nuclear energy levels - Analysis
664, 1388, 1392, 1944, 2446, 2750
Nuclear energy levels - Density
1388
Nuclear energy levels - Measurement
3015
Nuclear energy levels - Parity
657
Nuclear energy levels - Transitions
3025
Nuclear explosions - Radioactive fallout
351
Nuclear fission - Theory
664
Nuclear magnetic moments - Determination
2548, 2942
Nuclear magnetic moments - Mathematical analysis
2557
Nuclear magnetic moments - Measurement
480, 493
Nuclear magnetic moments - Optical analysis
896
Nuclear magnetic moments - Pairing forces
266
Nuclear magnetic relaxation - Measurement
1598
Nuclear magnetic resonance - Analysis
1552
Nuclear magnetic resonance - Applications
2444, 2445, 2744, 2745
Nuclear magnetic resonance - Mathematical analysis
502, 2876
Nuclear magnetic resonance - Measurement
746
Nuclear magnetic resonance - Molecules
1822, 1922, 2443
Nuclear magnetic resonance - Proton transfer
650-652
Nuclear magnetic resonance - Spectra
1702, 1921, 1923-1928, 2911, 2912
Nuclear magnetic resonance - Temperature factors
746
Nuclear particles
see Particles ; specific nuclear particles; e.g., Protons
Nuclear physics - Equations of state
2453
Nuclear physics - Spin properties
2296, 2297
Nuclear polarization - Analysis
1641
Nuclear polarization - Potential parameters
782
Nuclear quadrupole resonance - Application
2123, 2127
Nuclear quadrupole resonance - Spectra
1024

Subject Index

Nuclear quadrupole resonance - Zeeman splitting
2121, 2126
Nuclear reactions - Analysis
660, 1051-1053, 1055, 1438, 1590, 1770, 2008, 2081, 2084, 2446, 2447, 2577, 2579, 2585, 2586
Nuclear reactions - Annihilation
1408
Nuclear reactions - Disintegration energy
1383
Nuclear reactions - Energy
1141, 2083
Nuclear reactions - Energy levels
1385
Nuclear reactions - Mathematical analysis
1191-1193, 1195, 1200, 1204, 1205, 1208, 1769, 1822, 2004, 2301, 2553, 2560, 2564, 2838-2842, 2877-2881, 2885
Nuclear reactions - Model parameters
669
Nuclear reactions - Particle production
1370
Nuclear reactions - Separation energies
2082
Nuclear reactions - Stripping
1364, 1373, 2750
Nuclear reactions - Theory
1140, 1141, 1201
Nuclear reactors - Capabilities
2259
Nuclear reactors - Thermodynamics
1487
Nuclear resonance - Analysis
1438, 1535, 1922
Nuclear resonance - Iron isotopes
883
Nuclear resonance - Mathematical analysis
1396, 2544, 2554, 2943
Nuclear resonance - Spin coupling
1547
Nuclear scattering - Excitation energy
658
Nuclear scattering - Mass energy relation
776
Nuclear scattering - Mathematical analysis
263, 265, 268, 659, 665, 2299
Nuclear spins - Analysis
2551, 2556, 2913, 2914
Nuclear spins - Diffusion
481, 2442
Nuclear spins - Energy levels
2819
Nuclear spins - Mathematical analysis
502, 785, 1442, 2442, 2556, 2691
Nuclear spins - Measurement
269, 271, 272, 2442, 2527
Nuclear spins - Nuclear moments
2693
Nuclear spins - Optical analysis
896
Nuclear spins - Relaxation time
2746
Nuclear spins - Resonance
1182, 1183, 2444, 2445, 2532
Nuclear structure - Mathematical analysis
662, 2880
Nucleation - Mechanism
2748
Nuclei - Binding energy
2966
Nuclei - Charge distribution
1132-1134
Nuclei - Collisions
658
Nuclei - Decay
2577
Nuclei - Elastic scattering
665
Nuclei - Electromagnetic properties
1400
Nuclei - Electron transitions
675, 676, 2944
Nuclei - Hartree-Fock approximation
2966
Nuclei - Inelastic scattering
2576
Nuclei - Interactions
2009, 2300
Nuclei - Neutron capture
897
Nuclei - Nuclear energy levels
661, 675, 1376, 2750
Nuclei - Nuclear reactions
2556
Nuclei - Potential scattering
2007
Nuclei - Radioactive properties
896
Nuclei - Rotation
2942
Nuclei - Scattering
775
Nuclei - Vibrational frequency shifts
862
Nucleons - Coupling theory
262, 2839, 2840
Nucleons - Cross sections
3022
Nucleons - Decay
675
Nucleons - Dispersion relation
2548
Nucleons - Electromagnetic properties
2540, 2541
Nucleons - Electron collisions
2304
Nucleons - Form factors
514
Nucleons - Interactions
2009, 2258, 2268
Nucleons - Ionization potential
1369
Nucleons - Kinetics
2306
Nucleons - Magnetic moments
2559
Nucleons - Mathematical analysis
262

Nucleons - Nuclear cross sections
1192
Nucleons - Nuclear reactions
2547, 2551, 2560
Nucleons - Pion exchange
267
Nucleons - Polarization
3022
Nucleons - Potentials
2966
Nucleons - Scattering
142, 659, 1193, 1363, 1382, 1403, 2258, 2268, 2299
Nucleons - Structure parameters
267
Nuclidic Masses - Symposium
1141
Number theory - Applications
1866
Numerical data - Evaluation
1764
Numerical data - Processing
1764
Numerical integration
see also separate Mathematical Subject Classification, p. 903
Numerical integration - Applications
1108

Odd-odd nuclei - Energy
2551, 2556
Oils - Electrostatic precipitation
29, 30
Oils - Laboratory applications
2285
Olfactory nerve - Electrical responses
1071
Operations research - Bibliography
2786
Optic nerve (Cat) - Stimulation
2106, 2113-2115
Optic nerve (Frog) - Stimulation
1422-1424
Optic nerve (Monkey) - Color stimulation
793
Optic nerve (Octopus) - Stimulation
1105, 1106
Optical cortex (Rabbit) - Stimulation
2112
Optical equipment - Adaptation
1581
Optical equipment - Instrumentation
1539, 2411, 2835
Optical images - Mathematical analysis
1020
Optical instruments - Design
2087
Optical properties - Focusing
1404
Optical properties - Mathematical analysis
1839
Optical systems - Applications
603, 1225
Optical systems - Design
1049
Optical systems - Physiology
1423, 1424
Optical tracking - Mathematical prediction
893
Optics - Image formation
1020
Optics - Mathematical analysis
2407
Orbital flight paths - Computer analysis
2777
Orbital flight paths - Determination
335-337
Orbital flight paths - Mathematical analysis
1756, 1757, 2419
Orbital flight paths - Perturbations
2778
Organic acid salts - Dissociation
2287, 2289
Organic acids - Properties
2990
Organic acids - Solubility
1696
Organic compounds - Chemical reactions
198, 1913-1915, 2290, 2466, 2471, 2475
Organic compounds - Crystal structure
754, 1148
Organic compounds - Dielectric relaxation
625
Organic compounds - Electron spin resonance
1183, 2892
Organic compounds - Hydration
2470
Organic compounds - Infrared spectra
193
Organic compounds - Ionization potential
653
Organic compounds - Isomerism
2293
Organic compounds - Metalation
2290
Organic compounds - Microwave spectra
626, 628
Organic compounds - Molecular structure
533, 626, 628, 2341, 2472
Organic compounds - Paramagnetic resonance
2895
Organic compounds - Quantitative analysis
423
Organic compounds - Radiation effects
1186, 1187
Organic compounds - Spectra
2529
Organic compounds - Stability
475
Organic compounds - Synthesis
1913, 1915
Organic free radicals - Radiation effects
637
Organic halides - Dielectric properties
165
Organic halides - Flames
476

Subject Index

Organic halides - Nuclear magnetic resonance
1921-1928
Organic halides - Photochemistry
476
Organic halides - Spin-spin coupling
1927
Organic molecules - Spectroscopic analysis
485
Organic reactions - Mechanisms
198, 2471
Organic salts - Crystal structure
1953
Organic solvents - Chemical effects
1703
Organic solvents - Conductance
2336
Oscillators
see also specific types of oscillators, e.g., Microwave oscillators
Oscillators - Applications
1456
Oscillators - Design
1910, 2570
Oscillators - Instrumentation
2570
Oscillators - Noise parameters
1834
Oscillators - Performance
1459, 2599
Oscillators - Relaxation
1232
Oscilloscopes - Applications
1827, 1828
Oscilloscopes - Properties
1828
Oxalates - Growth requirement
1974
Oxalates - Metabolic requirements
1982
Oxidases - Inhibition
1986
Oxidases - Properties
1988
Oxidation-reduction reactions - Kinetics
413-415, 1750, 1840
Oxidation-reduction reactions - Mechanism
1973, 1981, 2341
Oxidation-reduction reactions - Metals
1750
Oxidation-reduction reactions - Quinones
2515
Oxidation-reduction reactions - Stability
2283, 2286
Oxidation-reduction reactions - X-ray analysis
2250
Oxides - Chemical bonds
2804
Oxides - Crystal structure
4
Oxides - Electrical properties
92
Oxoglutarate oxidation - Mechanism
1981
Oxygen - Chemical reactions
2340-2342
Oxygen - Electrochemical behavior
1652-1655
Oxygen - Electron transitions
550
Oxygen - Gamma radiation
662
Oxygen - Nuclear reactions
2081
Oxygen - Photoactivation
2084
Oxygen - Reaction kinetics
1781
Oxygen - Recombination reactions
25, 316
Oxygen - Ultraviolet spectra
550
Oxygen atoms - Recombination reactions
1998
Oxygen isotopes - Alpha bombardment
1368
Oxyhalides - Molecular structure
501
Ozone - Photochemical decomposition
847
Ozone - Reaction kinetics
1781
Ozonides - Synthesis
842, 843

Pair distribution - Bose gas
1240
Pair distribution - Mathematical analysis
3041
Pair distribution - Statistical analysis
1238
Palladium - Electrical potential
415
Palladium - Electron transition
64
Palladium - Free energy
412
Palladium - Hydrogen diffusion
20
Palladium - Hydrogen ionization
20
Palladium boride - Crystal structure
2802
Parabolic antennas - Design
2610, 2611, 2618, 2620
Parabolic antennas - Reflectors
2612
Paramagnetic crystals - Light modulation
744
Paramagnetic crystals - Optical properties
803
Paramagnetic crystals - Resonance
748, 1442
Paramagnetic crystals - Spin relaxation
481
Paramagnetic ions - Electron spin resonance
2914

Paramagnetic ions - Proton relaxation times
747
Paramagnetic ions - Resonance absorption
1644, 1645
Paramagnetic ions - Zero field splittings
811
Paramagnetic materials - Spin-lattice relaxation
2454
Paramagnetic relaxation - Electron spin effects
747
Paramagnetic relaxation - Measurement
487
Paramagnetic resonance - Hyperfine structure
2532
Paramagnetic resonance - Mathematical analysis
2533
Paramagnetic resonance - Measurement
2515, 2538
Paramagnetic resonance - Phonon distribution
1557
Paramagnetic resonance - Theory
504, 806, 1645
Paramagnetic resonance spectra - Pressure effects
748
Paramagnetic resonance spectra - Quadrupole constant
816
Paramagnetic resonance spectra - Rare earths
815
Paramagnetic resonance spectra - Thermal effects
809
Parametric amplifiers - Design
2477
Parity - Analysis
2549, 2565
Parity - Measurement
1201
Parkinson's disease - Electroencephalography
1292, 1732
Partial differential equations
see also separate Mathematical Subject Classification, p. 903
Partial differential equations - Applications
2157
Particle accelerators - Applications
2555, 2586, 2625, 2897
Particle accelerators - Design
2625
Particle accelerators - Development
2762
Particle accelerators - Electrostatic methods
2766
Particle accelerators - Ionization
2829
Particle accelerators - Operation
2978
Particle accelerators - Performance
2763
Particle beams - Optical analysis
1049
Particle beams - Production
2555
Particle beams - Separation
2587
Particle motion - Mathematical analysis
2722
Particles
see also specific particles, e.g., Protons
Particles - Angular distribution
1360, 1370
Particles - Atomic energy levels
661
Particles - Baryon composition
1360
Particles - Bombardment
1440
Particles - Capture
1053
Particles - Charge determination
1132-1135
Particles - Collisions
3018
Particles - Count-rate meters
1399
Particles - Coupling theory
146
Particles - Decay
1191, 1196, 1201, 1204, 1205, 2549, 2565
Particles - Determination
1222
Particles - Disintegration energy
1383
Particles - Dispersion relations
877
Particles - Electromagnetic coupling
1397
Particles - Electromagnetic properties
1400
Particles - Electron transitions
2559, 2561
Particles - Energy
2842, 2877, 2878, 2938
Particles - Energy levels
1359
Particles - Energy loss
1588
Particles - Energy spectra
1361
Particles - Excitation
259
Particles - Gravity-energy relation
147
Particles - Identification
1135
Particles - Impact
2825
Particles - Interactions
2406, 2664, 2885
Particles - Ionization
1588, 2783, 2784
Particles - Kinetics
1360, 2404
Particles - Line broadening
3016
Particles - Magnetic properties
1674
Particles - Mass-energy relation
776, 1042, 1044, 1046, 2764

Subject Index

Particles - Motion
275, 714, 1100, 1102, 1213, 1221, 1225, 2262, 2650, 2722, 2878, 2940
Particles - Nuclear energy
256, 262
Particles - Nuclear reactions
1050-1053, 1055, 1208, 2838, 2840, 2841
Particles - Nuclear spins
2691
Particles - Nuclear structure
662, 2554
Particles - Pair production
2552
Particles - Parity
1051, 1055
Particles - Photoelectric effects
2555
Particles - Polarization
2265
Particles - Propulsion
2762-2764
Particles - Scattering
252, 253, 255, 257, 268, 379-381, 384-386, 388, 775, 1197, 1202, 1206, 1235, 1239, 1376, 1389, 2540, 2558, 2560, 2563, 2582, 2586, 2787, 2875, 2887, 2938
Particles - Spectra
1381, 2204, 2205, 2254
Particles - Spin configuration
1397, 1402, 2296
Particles - Statistical mechanics
694, 695, 698
Particles - Symmetry
2265
Particles - Theory
714, 1201, 2267
Particles - Transitions
3030
Particles - Transport properties
1232
Particles - Vaporization
2830
Particles - Velocity
702, 703, 2827, 2828
Pellets - Launching
2826
Penetration of Charged Particles in Matter - Symposium
1759
Pentanols - Synthesis
3036
Peptides - Molecular structure
2899
Perception - Anticipating tests
1284
Perception - Mathematical analysis
425
Perception (Physiological) - Test methods
398, 521
Perchlorates - Applications
2426-2428, 2430
Perchlorates - Decomposition
61
Perchloric acid - Decomposition
73
Perfluoroalkyl lead compounds - Synthesis
788
Perfluoroalkyl manganese carbonyls - Synthesis
792
Perfluoroalkyl rhenium carbonyls - Synthesis
792
Perfluoroalkyl tin compounds - Synthesis
788
Perfluorovinyl boron compounds - Synthesis
790
Perfluorovinyl metal compounds - Infrared spectra
791
Perfluorovinyl tin compounds - Properties
787
Perfluorovinyl tin compounds - Synthesis
787
Peroxides - Chemical reactions
823-825
Personality - Classification
976
Personality - Prejudice
2757
Personality - Research
1795
Personality - Statistical analysis
2697
Personality tests - Analysis
1772-1774, 1794-1796
Personnel - Psychological factors
1935, 1937
Perturbation theory - Analytical properties
378, 388
Perturbation theory - Applications
378, 379, 381, 382, 384, 385, 1021, 1194, 1198, 1215, 1237, 1358, 1442, 1681, 1769, 1801, 1930, 1931, 2144, 2267, 2366
Perturbation theory - Mathematical analysis
1198, 2939
Phase shifters - Theory
1910
Phase transitions - Mathematical analysis
1812
Phenolic salts - Alkylation
2291
Phenylalanine - Autoxidation
1707
Phonons - Relaxation spectra
1557
Phonons - Scattering
1235
Phosphides - Crystal structure
2803
Phosphides - Phase transitions
2803
Phosphorescent decay - Pressure effects
838, 840
Phosphorus compounds - Crystal structure
2800, 2808
Phosphorus isotopes - Energy transfer
1372
Phosphorus isotopes (Radioactive) - Spectra
2815
Photochemical reactions - Analysis
1704, 2397

Photoelectric cells - Current output
2409
Photoelectric cells - Performance
2907, 2918
Photographic emulsions - Analysis
1588, 2950
Photographic emulsions - Applications
1042, 1044, 1045, 1590, 1591, 2664, 2666
Photographic emulsions - Development rate
160
Photographic emulsions - Energy spectra
2405, 2884
Photographic emulsions - Mathematical analysis
2885
Photographic emulsions - Radiation effects
1048
Photographic emulsions - Ultrasonic radiation
160
Photographic equipment - Design
681
Photographic lenses - Design
1047
Photography - Physical chemistry
2899
Photometers - Applications
2204
Photometric titration - Chemical analysis
1064
Photomultipliers - Applications
1453, 1943
Photomultipliers - Instrumentation
1453
Photomultipliers - Operation
1943
Photomultipliers - Refrigeration systems
1943
Photons - Correlation techniques
2409
Photons - Energy
2815
Photons - Kinetics
2306
Photons - Nuclear reactions
2558
Photons - Scattering
1358
Photonuclear reactions - Analysis
2081, 2084, 2853, 2854
Photonuclear reactions - Separation energies
2085
Photoperiodism - Research
2994, 2996, 2997
Photoproduction - Detection
2303
Photoprotons - Production
2569
Photoreceptors - Color
999, 1010
Photosensitized reactions - Mechanisms
2809
Photosynthesis - Theory
2392
Phthalic anhydride - Hydration
2470
Physical Chemistry in Aerodynamics and Space Flight - Symposium
2071
Physics - Boundary value problems
614
Physics laboratories - Geography
1823
Physiological responses - Chang effect
2117
Picrylaminocarbazyl - Specific heat
2534
Piezoelectric crystals - Neutron analysis
2068
Piezoelectric crystals - X-ray analysis
2068
Pigeons - Mating
2789
Pilobolus - Circadian rhythms
2225
Pilots - Electroencephalography
537
Pion exchange - Dispersion theory
2258
Pions
see also Mesons
Pions - Annihilation reactions
2811
Pions - Binding energy
2303
Pions - Decay
1405
Pions - Electroproduction
2304
Pions - Exchange reactions
2258
Pions - Interactions
2255, 2268
Pions - Nuclear reactions
2004
Pions - Scattering
1363, 1405, 2255, 2268
Pions - X-ray distribution
2404
Piperidine - Infrared spectra
193
Pipes - Glass
23
Pitot tubes - Applications
2202
Pitot tubes - Gas flow
2198
Pituitary gland - Hormonal influence
2093
Pituitary gland - Surgery
2095
Pituitary hormone - Hormonal control
2098
Pituitary hormone - Hypothalamic control
2094
Pituitary hormone - Inhibition
2096
Pituitary hormone - Properties
2095

Subject Index

Pituitary hormone - Synthesis
2096
Plasma acceleration - Electric field
2311-2313, 2315-2318
Plasma accelerators - Design
2359
Plasma accelerators - Electrodes
213
Plasma accelerators - Mathematical analysis
82
Plasma Dynamics - Symposium
1761
Plasma generators - High temperature tunnels
711
Plasma generators - Performance
2856
Plasma jets - Atom concentrations
10
Plasma jets - Electrical conductance
2132
Plasma jets - Electromagnetic acceleration
41, 2133
Plasma jets - Electron temperature
311
Plasma jets - Fluid flow
2132
Plasma jets - Hydrogen
2134
Plasma jets - Ion concentration
311
Plasma jets - Production
2856
Plasma jets - Propellants
2130
Plasma jets - Propulsion
2134
Plasma jets - Supersonic flow
311
Plasma jets - Velocity
2132
Plasma motors - Design
2656
Plasma motors - Operation
2652, 2656
Plasma oscillations - Emissivity
206
Plasma oscillations - Mathematical analysis
206, 752, 1957
Plasma oscillations - Theory
2596
Plasma physics
1229, 1436, 1441, 1446, 1529, 1549, 1550, 1558 1577, 1680, 1878, 1956-1959, 1993, 2012, 2131, 2132, 2134, 2161, 2175, 2181, 2182, 2476-2478, 2491, 2596, 2598, 2623, 2629, 2652-2656, 2724, 2765, 2832, 3011, 3013, 3017
Plasma physics - Correlation techniques
81
Plasma physics - Electric fields
2311-2318
Plasma physics - Electromagnetic factors
1102, 1103, 1990, 2650
Plasma physics - Electrons
1264
Plasma physics - Hydrogen
206
Plasma physics - Mathematical analysis
2011, 2651
Plasma physics - Rocket propulsion
71, 83, 84
Plasma propulsion
2130, 2133, 2360, 2656
Plasmas - Accelerators
41, 2311, 2312, 2315-2318
Plasmas - Chemical analysis
1989
Plasmas - Conductivity
2132, 2493
Plasmas - Cyclotron radiation
1490, 1549
Plasmas - Dynamics
2652
Plasmas - Electromagnetic fields
2314
Plasmas - Electron density
1038-1041, 1272, 1957, 2476
Plasmas - Electron oscillations
2492
Plasmas - Electron velocities
1550
Plasmas - Gas dynamics
2012
Plasmas - Ion density
3017
Plasmas - Ionization
3011
Plasmas - Irreversible processes
693, 696, 697
Plasmas - Kinetics
1488
Plasmas - Line spectra
3020
Plasmas - Magnetic field effects
2653-2655
Plasmas - Mathematical analysis
199, 2181
Plasmas - Microwave emission
1558
Plasmas - Microwave interactions
2491
Plasmas - Microwave radiation
1489, 1530, 2598
Plasmas - Noise radiation
1554
Plasmas - Particle acceleration
1529
Plasmas - Photographic analysis
2832
Plasmas - Physical factors
1769, 1770
Plasmas - Properties
2832
Plasmas - Radiation
1038
Plasmas - Reactance properties
2477
Plasmas - Refractive index
199

Plasmas - Shock waves
77
Plasmas - Spectrographic analysis
2182, 3010
Plasmas - Stability
2653, 2654
Plasmas - Statistical mechanics
696, 697, 700
Plasmas - Theory
2181, 2477
Plasmas - Thermodynamics
1489, 1554, 2356, 2651
Plasmas - Transport properties
1488
Plasmas - Turbulence
75
Plasmas - Velocity
2132
Plasmas - Velocity distribution
1559
Plastic deformation - Inelasticity
2704
Plastic sheets - Applications
1749
Plasticity - Analysis
2521
Plasticity - Mathematical analysis
354, 600, 601, 2148, 2150, 2523
Plasticity - Theory
601
Plastics - Mechanical properties
2704
Plate theory - Mathematical analysis
1304
Plates
see also Sheets
Plates - Heat transfer
543
Plates - Hypersonic flow
543, 545
Platinum - Chemical reactions
957
Platinum - Crystal structure
2396
Platinum - Heat transfer
1325
Platinum - Ion bombardment
595
Platinum - Secondary emission
595
Platinum metals - Crystallography
2803
Platinum wire - Quenching
432
Polarization - Mathematical analysis
1409
Polarization - Measurement
2881
Polarization - Nuclei
1599, 1726
Polarization - Scattering
3023
Polarized light - Measurement
2834
Polarized x-rays - Applications
2588
Polarographs - Design
1939
Political science - Theory
515-522
Polyatomic molecules - Vibrational relaxation
2102
Polyethylene - Radiation effects
1726
Polymers - Molecular structure
186
Polymers - Radiation effects
350
Polystyrene sulfonic acid - Ionization
463
Polystyrene sulfonic acid - Magnetic resonance
463
Polytributyltin methacrylate - Synthesis
841
Porous materials - Diffusion
1725
Porous materials - Heat transfer
1418
Porous materials - Laminar flow
2158
Positrons - Annihilation
1408, 2750
Positrons - Decay
1374, 2549, 2565, 2750
Positrons - Scattering
2589
Potassium - Chemical reactions
724
Potassium bromide crystals - Color centers
888
Potassium-carbon monoxide reactions - Properties
724
Potassium chloride crystals - Band spectra
2010
Potassium chloride crystals - Color centers
888, 893, 1646
Potassium chloride crystals - Hall effect
893
Potassium chloride crystals - Photoconductivity
891
Potassium chloride crystals - Physical properties
1354
Potassium compounds - Chemical reactions
1649
Potassium compounds - Substitution reactions
1651
Potassium compounds (Organic) - Chemical reactions
2904
Potassium compounds (Organic) - Crystal structure
2905
Potassium compounds (Organic) - Preparation
2904
Potassium crystals - Anisotropy
2124
Potassium halide crystals - Color centers
887
Potassium halide crystals - Resonance absorption
886

Potassium hexahydroxybenzoate - Synthesis
724
Potassium-iron-chloride complexes - Dissociation
495
Potassium isotopes (Radioactive) - Magnetic moments
2559
Potassium-nitrogen systems - Potentials
496
Potassium perchlorate - Decomposition
61
Potassium perchlorate - Reaction kinetics
61, 62
Potassium pyrenide - Spectra
2536
Potassium systems - Potentials
496
Potential scattering - High energy limit
2787
Potential scattering - Mathematical analysis
2007, 2539
Potential scattering - Theory
2787
Potentials - Electric fields
1100
Potentials - Time-dependent fields
1100, 1101
Potentials (Brain) - Habituation
2105
Potentiometers - Applications
12
Powder metals - Electrical properties
93
Powdered solids - Shock excitation
2962
Powders - Phase transitions
2141
Power supplies - Characteristics
2355
Praseodymium isotopes (Radioactive) - Polarization
2890
Praseodymium nitrites - Molecular structure
2284
Praseodymium oxide - Phase transitions
2283, 2286
Praseodymium oxide - Resistivity
2283
Praseodymium oxide - Stoichiometry
2283
Precipitation chemistry - Bibliography
608
Pregnancy - Hormone physiology
2094
Pressure - Measurement
2248
Pressure - Physical effects
1346
Pressure - Research techniques
1346
Pressure distribution - Mathematical analysis
925
Pressure gages - Design
2480
Probability
see also separate Mathematical Subject Classification, p. 903
Probability - Symposium
250
Probability (Statistics) - Applications
1875, 1876
Probes (Electromagnetic) - Operation
2570
Problems Related to Interplanetary Matter - Symposium
1763
Projectiles - Aerodynamic characteristics
2732
Projectiles - Aluminum
1035, 1036
Projectiles - Impact shock
1035, 1036
Propellants
see also specific propellants, e.g., Liquid propellants, Solid propellants
Propellants - Emission spectra
207
Propellants - Ignition
2824
Propellants - Properties
2130
Propellants - Shock waves
207
Propellants (Aerial) - Aerodynamic characteristics
580
Proportional counters - Performance
1824
Proprioception - Stimulation
1634
Proprioception (Rat) - Adaptation
1111
Propulsion - Chemical kinetics
709
Propulsion - Ion rockets
1833, 2354
Propulsion - Magnetohydrodynamics
2353
Propyl radicals - Electronegativity
506
Propyl radicals - Nuclear magnetic resonance
505
Protamines - Metabolism
1572
Proteins - Electron spin resonance
631-633
Proteins - Free radical structure
637
Proteins - Metabolism
1572
Proteins - Molecular structure
631
Proteins - Morphological characteristics
691
Proteins - Radiation effects
631-633, 642
Proteins - Synthesis
2982, 2984
Proton accelerators - Design
2951

Proton accelerators - Operation
2951
Proton beams - Physiological effects
2790, 2792, 2793
Proton beams - Reproductive changes
2789
Proton beams - Vascular charges
2788, 2791
Proton cross sections - Mathematical analysis
268, 732
Proton cross sections - Measurement
735
Proton scattering - Electromagnetic factors
2592
Protons
see also Antiprotons
Protons - Angular distribution
1361, 1364, 1373
Protons - Annihilation reactions
2811
Protons - Bombardment
1366
Protons - Decay
2591
Protons - Determination
1221, 1223
Protons - Elastic scattering
656, 2446, 2447
Protons - Energy
1226, 2569, 2852
Protons - Energy spectra
1361, 2301
Protons - Furry theorem
2302
Protons - Measurement
444, 445, 452, 1387
Protons - Nuclear reactions
2008, 2301, 2552, 2561
Protons - Nuclear spin
1709, 2746
Protons - Polarization
1726, 2444, 2446, 2447
Protons - Relaxation time
1920, 2744
Protons - Resonance
1082-1086
Protons - Resonance spectra
2528, 2529, 2535, 2536
Protons - Scattering
268, 668, 1375, 1407, 2592
Protons - Spectra
1407, 2892
Protons - Stripping properties
1364
Pseudomonas - Carbon assimilation
1982, 1983
Pseudomonas - Metabolism
1974, 1975, 1982
Psilocine - Oxidation reactions
1988
Psychoacoustics - Test methods
1615
Psychoacoustics - Theory
1615
Psychodynamic variables - Data processing systems
728
Psychology - Theory
2243
Psychometrics - Statistical analysis
1008
Psychomotor tests - Analysis
2661
Psychomotor tests - Multidimensional tracking
898
Psychotropic drugs - Conditioning studies
2102
Pulse amplifiers - Design
2703
Pulse generators - Theory
2644
Pulse height - Measurement
2852
Pulse modulation - Mathematical analysis
284, 288
Pulse transmitters - Design
1499
Pumps - Instrumentation
2707
Pyrene ions - Spin density
2894
Pyridine compounds - Synthesis
2475
Pyridine crystals - Molecular structure
1951, 1952
Pyridines - Chemical reactions
848, 2988
Pyridines - Electron transitions
2988
Pyridines - Infrared spectra
193
Pyridines - Ionization potential
653
Pyridines - Methyl effects
2987
Pyridines - Spectra
2987
Pyridines - Synthesis
848
Pyrolysis - Mechanism
2836
Pyrone salts - Molecular structure
1953

Quadrupole moments - Determination
816
Quadrupole moments - Mathematical analysis
640, 1140
Quantitative analysis - Computing procedure
2349
Quantitative Biology - Symposium
1114
Quantum Chemistry - Symposium
2415
Quantum electrodynamics - Electron proton scattering
368
Quantum electrodynamics - Form factors
366, 367

Subject Index

Quantum electrodynamics - Mathematical analysis
781
Quantum electrodynamics - Pair production
2549, 2565
Quantum electrodynamics - Theory
366-368, 783
Quantum field theory - Mathematical analysis
1199, 2843
Quantum field theory - Perturbation theory
778, 1206
Quantum mechanics - Applications
2899
Quantum mechanics - Bosons
2886
Quantum mechanics - Dispersion theory
2548, 2690
Quantum mechanics - Field theory
137-139, 380-382, 384, 385, 1362, 1394, 1398, 1402, 1844-1846, 1848, 2260, 2266, 2270, 2539, 2843, 2888
Quantum mechanics - Gases
2192
Quantum mechanics - General relativity
1843
Quantum mechanics - Lectures
1203
Quantum mechanics - Magnetic fields
2688
Quantum mechanics - Mathematical analysis
154, 184, 252, 277, 379, 386, 408, 409, 411, 437, 438, 770-772, 774, 779, 780, 786, 1195, 1197, 1202, 1207, 1215, 1396, 1603, 2269, 2546, 2563, 2726, 2839, 2876, 2938, 2940, 2941, 2943, 2944
Quantum mechanics - Nuclear reactions
2009
Quantum mechanics - Statistical analysis
1497, 1813, 1814
Quantum mechanics - Theory
154, 1199, 1206, 1946, 2540, 2541, 2718
Quantum mechanics - Wigner rule
1946
Quantum statistics - Pair distribution
1238
Quantum statistics - Statistical functions
1215
Quartz crystals - Applications
2816
Quinones - Electron spin resonance
1708
Quinones - Spectrographic analysis
1708

Radar echoes - Analysis
857
Radar operators - Vision
1001, 1005
Radiation - Chemical effects
349, 350
Radiation - Cooling
5
Radiation - Coulomb excitation
3025
Radiation - Line spectra
1490, 1491
Radiation - Mathematical analysis
5, 208, 209
Radiation - Measurement
1048, 2452
Radiation - Reflection
1223
Radiation - Shielding
1048
Radiation - Telescopic measurement
2455, 2456
Radiation - Thermodynamics
1540
Radiation belt - Mathematical analysis
454
Radiation belt - Measurement
1227
Radiation counters - Applications
1825
Radiation counters - Design
101, 102
Radiation damage - Analysis
982, 2024
Radiation damage - Crystal structure
980
Radiation detections - Instrumentation
1371, 1390, 1399
Radiation detectors - Design
1556
Radiation rate - Analysis
836
Radicals - Chemical reactions
2017, 2466, 2472
Radio astronomy - Instrumentation
2612-2614, 2616, 2619, 2620
Radio astronomy - Masers
510
Radio communication systems - Analysis
1431
Radio receivers - Performance
1466
Radio signals - Multiplex transmission
1431
Radio waves - Mathematical analysis
1532
Radio waves - Propagation
2271
Radio waves - Spectrographic analysis
2615
Radioactive decay - Analysis
1189-1191
Radioactive decay - Mathematical analysis
1194
Radioactive decay - Measurement
2403
Radioactive decay - Research
1204, 1205
Radioactive fallout - Measurements
351
Radioactive fallout - Stratospheric mixing
351
Radioactive isotopes - Tracer analysis
820, 1894

Radiobiology
2768-2793
Radiofrequency - Mathematical analysis
1551
Radiofrequency discharge - Phase shift
2486
Radiofrequency filters - Applications
1788
Radiofrequency filters - Design
286
Radiofrequency power - Energy absorption
2445
Radiofrequency power - Theory
1789, 2598
Radiofrequency pulses - Plasma acceleration
2311-2313, 2315-2318
Radiography - Apparatus
1067
Radioisotopes
see also Isotopes (Radioactive)
Radioisotopes - Applications
1576, 1974
Radioisotopes - Decay
2577
Radiometers - Instrumentation
2617
Radiometers - Performance
2617
Rare earth acetates - Chemical reactions
864
Rare earth acetates - Synthesis
864
Rare earth disilicides - Polymorphism
2140
Rare earth fluorides - Density
2741
Rare earth iodides - Chemical reactions
863
Rare earth iodides - Synthesis
863
Rare earth ions - Electron transitions
814
Rare earth ions - Magneto-optic rotation
744
Rare earth ions - Paramagnetic resonance
809, 813, 815
Rare earth ions - Spectrographic analysis
1056
Rare earth isotopes (Radioactive) - Quadrupole moment
2018
Rare earth oxides
see Rare earths
Rare Earth Research - Symposium
231
Rare earths - Phase studies
1911
Rare earths - Spectrographic analysis
803, 804
Rare earths - Thermodynamics
1912
Rare earths - Vaporization
1911, 1912
Rare gases
see also specific gases, e.g., Argon
Rare gases - Adsorption
2908
Rare gases - Ionization
187
Rare gases - Recombination reactions
187
Rare gases - Surface properties
2908
Rarefied gas dynamics
2136-2139, 2433, 2489, 2898
Rarefied gases - Kinetic theory
140
Reaction (Physiology) - Mathematical analysis
1526
Reaction (Physiology) - Thalamic stimulation
1732, 1735
Reaction (Physiology) - Tone
950, 952
Reaction (Physiology) - Warning signal
2111
Reaction (Psychology) - Aggression
2756
Reaction (Psychology) - Analysis
190-192, 1633
Reaction (Psychology) - Frustration
2756
Reaction (Psychology) - Nuclear attack
832-834
Reaction (Psychology) - Opossum
127
Reaction (Psychology) - Perceptual responses
398
Reaction (Psychology) - Psychological factors
369, 620-624, 1936
Reaction (Psychology) - Statistical analysis
2862-2864
Reaction (Psychology) - Test methods
129, 620, 621, 767, 768, 1634, 1875, 1876, 1935, 2244, 2758
Reaction (Psychology) - Tracking phenomena
900, 901
Reaction (Psychology) - Visual tracking
899
Reaction kinetics - Measurement
2206
Reaction kinetics - Test equipment
2861
Reaction time - Measurement
2661
Reactor research - Breeders
2259
Reactor research - Burners
2259
Reactors - Applications
2206
Reactors - Thermodynamics
1487
Reading speed - Physical factors
997, 1001, 1002
Reasoning - Mathematical analysis
1744, 1933, 1934
Reasoning - Theory
1744

Recombination reactions - Kinetics
25, 2742, 2743
Recombination reactions - Mechanism
1998, 2000, 2988
Recombination reactions - Propulsion systems
26
Re-entry aerodynamics - Mathematical analysis
2152, 2155, 2156, 2419
Re-entry trajectories - Mathematical analysis
2152, 2155, 2419
Re-entry vehicles - Aerodynamic heating
2156
Reflectometers - Design
2416
Reflector antennas - Performance
2468
Reflectors - Applications
2467
Reflexes - Carbon dioxide sensitivity
1077
Reflexes (Frog) - Mechanism
1661
Relativity theory - Accelerated systems
2753
Relativity theory - Celestial mechanics
2261
Relativity theory - Clock paradox
862
Relativity theory - Field theory
1847
Relativity theory - Gravitational shift
2753
Relativity theory - Lectures
1203
Relativity theory - Mathematical analysis
137, 143-147, 1199, 2006, 2545, 2717, 2719-2721, 2723, 2725, 2841, 2998
Relativity theory - Quantum mechanics
1398, 1402, 1405, 1843, 1848, 2269
Relativity theory - Test methods
2542
Relativity theory - Time dilation
1456
Relaxation - Theory
2454
Relaxation time - Analysis
2744
Relaxation time - Mathematical analysis
1269, 2454
Relaxation time - Measurement
1920, 2192, 2442, 2443, 2889
Relaxation time - Thermodynamics
2198
Renal function - Adrenalectomy
2993
Renal function - Desoxycorticosterone
2993
Reproduction (Pigeons) - Physiological changes
2789
Research
see Scientific research
Reserpine - Metabolic effects
1130
Reserpine - Physiological effects
1075
Resistors - Applications
2649
Resistors - Electrical properties
1544
Resonance absorption - Measurement
2513
Resonance scattering - Mathematical analysis
2690
Resonant modes - Design
2601
Resonant modes - Mathematical analysis
2086, 2601
Respiration (Mammalian) - Gaseous ion effects
331
Retina - Dark adaptation
995, 999, 1001, 1005
Retina - Light adaptation
995, 1001, 1010, 1011, 1014, 1015
Retina - Sensitivity
998, 1003, 1004, 1006, 1008, 1011, 1013-1015, 1105, 1106
Retina - Stimulation
1009
Retina (Cat) - Dark adaptation
2106, 2110
Retina (Cat) - Photic stimulation
2106, 2109
Retina (Cat) - Visual deafferentation
2106
Retina (Frog) - Nerve cells
1423
Retina (Frog) - Physiology
1421
Retina (Frog) - Sensitivity
1421
Retina stimulation (Cat) - Response
2116
Retinene - Photochemical reactions
1704
Rhenium - Spectrophotometric analysis
45, 46
Rhenium compounds - Crystal structure
2800
Rhenium compounds - Properties
1650
Rhenium compounds - Synthesis
1650
Rhodium salts - Properties
1882
Rhodium salts - Synthesis
1882, 1883
Ribonucleic acids - Physiological factors
691
Riveted stiffeners - Fracture
394
Rochelle salt - Electrical properties
2062
Rochelle salt - Phase transitions
2062, 2068
Rocket combustion - Ion concentration
2761

Rocket flames – Ionization
2759, 2760
Rocket motors - Combustion chambers
2307, 2388, 2662
Rocket motors - Fuels
2308
Rocket motors - Instrumentation
2310
Rocket motors - Operation
2360
Rocket propellants
see also Liquid rocket propellants; Solid propellants
Rocket propellants - Condensation
708
Rocket propelled sleds - Optical monitoring
603
Rocket propelled sleds - Velocity
604
Rocket propulsion - Performance
2130
Rocket trajectories - Mathematical analysis
2157, 2159
Rockets - Applications
1180, 1181
Rodents - Circadian rhythms
2994-2997
Rodents - Phase control
2995
Rodents - Physiology
2095
Rods - Purification
1918
Rods - Stresses
2519
Rubidium crystals - Phase transitions
2058
Rubidium hydrogen sulfate - Molecular structure
2058
Ruby - Electron spin resonance
1641, 1642
Ruby - Modulated dichroism
744
Ruby - Nuclear spins
1603
Ruby - Spectrographic analysis
812
Ruby (Synthesis) - Nuclear magnetic resonance
480
Ruthenium - Atomic spectra
63, 65
Ruthenium - Electron transitions
65
Ruthenium compounds - Crystal structure
2794, 2799
Rutile crystals - Nuclear spins
511
Rutile crystals - Paramagnetic resonance
511, 512
Rutile crystals - Resonant frequency
513
Salt solutions - Ion association
1592
Salt solutions - X-ray diffraction analysis
1592
Salts - Crystal structure
2432
Salts - Electrical properties
2334
Salts - Physical properties
1411, 2334
Samarium isotopes - Bombardment
1366
Samarium isotopes - Excitation
666
Samarium isotopes - Inelastic scattering
666
Sampled-data control systems - Asymptotic stability
287
Sampled-data control systems - Mathematical analysis
284, 285, 289, 291, 355, 358, 365, 2642
Sampled-data control systems - Statistical analysis
2635
Sandwich panels - Design
1677
Sandwich panels - Elasticity
1678, 1679, 2167
Sandwich panels - Heat transfer
1297
Sandwich panels - Mechanical properties
1677
Sandwich panels - Stresses
1678, 1679
Sandwich panels - Theory
2165, 2166
Sandwich panels - Vibration
1678, 2165-2167
Sapphires
see also Alumina; Corundum
Sapphires - Crystal structure
50, 51
Sapphires - Dielectric properties
50, 51
Sapphires - Electron spin resonance
1640
Sapphires - Optical properties
1061
Satellite vehicle trajectories - Mathematical analysis
335-337, 2419
Satellite vehicles - Aerodynamics
2479
Satellite vehicles - Flight paths
1756, 1757
Satellite vehicles - Orbit determination
715, 2777
Satellite vehicles - Perturbations
2778
Satellites (Artificial) - Cosmic ray detection
444-446, 450
Satellites (Artificial) - Drag
1229
Satellites (Artificial) - Motion
2487
Scandium isotopes - Electron transitions
656

Subject Index

Scandium isotopes - Nuclear band structure
656
Scattering
see also as a subdivision, e.g., Electrons - Scattering
Scattering - Mathematical analysis
277, 775, 2270
Scattering (Small angle) - Measurement
844
Scattering theory - Mathematical analysis
2879
Scientific information - Retrieval
2030
Scientific instruments - Absorption spectrum
299
Scientific instruments - Control
12
Scientific instruments - Design
956, 1387, 2087
Scientific instruments - Polarization studies
66
Scientific instruments - Solubility studies
47
Scientific organizations - Latin America
2462
Scientific research - Physiology
2103
Scintillation counters - Applications
1777, 2457
Secondary emission - Mathematical analysis
923
Selenates - Crystal structure
2429
Selenium isotopes - Decay
2821
Selenium isotopes - Nuclear energy levels
2813
Selenium isotopes - Spectra
2813, 2821
Selenium isotopes (Radioactive) - Decay
2812
Selenium isotopes (Radioactive) - Spectra
2812
Semiconductor Nuclear Particle Detectors - Symposium
1760
Semiconductors - Bibliography
94, 95
Semiconductors - Diamonds
1938
Semiconductors - Electrical conductivity
85, 91
Semiconductors - Electrical properties
92, 93, 1090, 1663, 1667, 1670, 1681
Semiconductors - Electromagnetic properties
53, 85, 89-91, 1682
Semiconductors - Electron mobility
1233
Semiconductors - Germanium
2930, 2932
Semiconductors - Hall effect
1682
Semiconductors - Impurities
1217
Semiconductors - Infrared spectra
2683
Semiconductors - Magnetoresistance
85, 91
Semiconductors - Mathematical analysis
1233
Semiconductors - Metalorganic compounds
841
Semiconductors - Microwave conductivity
1681
Semiconductors - Optical properties
1090, 1663, 1664, 1668, 1669, 1938
Semiconductors - Paramagnetic resonance
2683, 2684
Semiconductors - Photochemical reactions
55
Semiconductors - Powder metals
93
Semiconductors - Properties
1089
Semiconductors - Silicon
2931, 2934
Semiconductors - Surface properties
988, 1666, 2930, 2932, 2933
Semiconductors - Thermal properties
1090
Semiconductors - Transition patterns
2413
Semiconductors - Transport properties
87, 91
Semiquinones - Electron spin resonance
503, 1705
Semiquinones - Resonance
2513, 2515, 2517
Semiquinones - Spectra
2514
Sensory Communication - Symposium
1420
Sensory deprivation - Psychological factors
620, 623, 624
Sensory impulses - Central regulation
2118
Sensory perception - Attention response
1970
Sensory perception - Itch
1458
Sensory perception - Mathematical analysis
1614
Sensory perception - Pain
1458
Sensory perception - Physiological factors
1150, 1152, 1157-1159, 1161-1169
Sensory perception - Psychological factors
620, 623, 624
Sensory perception - Psychophysical analysis
2658
Sensory perception - Stimulation
1531
Sensory perception - Test methods
1464, 2658
Sensory perception - Theory
1464
Sensory perception - Vibration
1458

Sensory receptors - Capabilities
42
Sequences
see also separate Mathematical Subject Classification, p. 903
Sequences - Error correction
1865
Sequences - Geometry
1854
Sequential analysis
see also separate Mathematical Subject Classification, p. 903
Sequential analysis - Applications
1863, 1872
Servo systems - Design
2642
Servo systems - Mathematical analysis
356, 357, 359, 361-363, 1789, 1791, 2635, 2648
Sexual behavior (Cat) - Stilbestrol effects
1570
Sexual behavior (Rodent) - Control
1966
Sheets - Elasticity
1803, 1805
Sheets - Flow fields
2162
Sheets - Heat transfer
178
Sheets - Hypersonic flow
2319, 2323
Sheets - Laminar boundary layer
1779, 1780
Sheets - Mathematical analysis
671
Sheets - Shear flow
2332
Sheets - Stability
2321
Sheets - Stresses
1298, 1801, 1802, 1804, 2147, 2149
Sheets - Turbulent boundary layer
175, 1779, 1780
Sheets - Vibration
671, 2166
Shock tubes - Applications
204, 550-553, 1621-1623
Shock tubes - Design
346
Shock tubes - Electronic transitions
203
Shock tubes - Wave patterns
305
Shock wave radiation - Measurement
79
Shock waves - Analysis
1613, 1623, 2498, 2502-2504
Shock waves - Applications
2216, 2824
Shock waves - Elastic-plastic theory
2498, 2503
Shock waves - Electron distribution
1265, 1266, 1268, 1272, 1275
Shock waves - Gas ionization
187
Shock waves - Hypersonic flow
2153
Shock waves - Ion distribution
1275
Shock waves - Ionization
2833
Shock waves - Magnetic field effects
1263
Shock waves - Magnetohydrodynamics
77, 1879
Shock waves - Mathematical analysis
549, 1956, 2153, 2211, 2224, 2435, 2436, 2490, 2710, 2826
Shock waves - Photographic analysis
207, 2501, 2832
Shock waves - Physical effects
74, 75, 2739
Shock waves - Pressure effects
1337, 2945
Shock waves - Propagation
1262, 1271, 1605, 1817-1819
Shock waves - Properties
2502
Shock waves - Radiation effects
76, 79
Shock waves - Supersonic flow
2781, 2782
Shock waves - Temperature factors
2945, 2962
Shock waves - Theory
180
Signal detection - Background noise
1509
Signal detection - Error rate
1509
Silanes - Chemical reactions
2904
Silanes - Crystal structure
2905
Silanes - Preparations
2904
Silanes - Thermodynamic properties
193
Silicates - Crystal structure
4
Silicates - Thermal transformation
4
Silicides - Crystal structure
2795, 2797, 2798
Silicides - Properties
2795
Silicon - Electron transfer
2684
Silicon - Impurities
2683
Silicon - Infrared spectra
2683
Silicon - Paramagnetic resonance
2683
Silicon alloys - Heat content
330
Silicon compounds - Crystal structure
2801

Subject Index

Silicon compounds (Organic) - Chemical reactions
2904, 2906
Silicon compounds (Organic) - Combustion
195
Silicon compounds (Organic) - Crystal structure
2905
Silicon compounds (Organic) - Preparation
2904, 2906
Silicon crystals - Growth
2931
Silicon crystals - Radiation effects
2593
Silicon crystals - X-ray diffraction analysis
851
Silicon isotopes - Alpha bombardment
1368
Silicon isotopes - Energy levels
1375
Silicon isotopes - Neutron threshold
670
Silicones - Combustion
195
Siloxanes - Basicities
2989
Silver - Diffusion
881
Silver - Gamma rays
2891
Silver - Reaction kinetics
62
Silver - Thermal vibrations
67
Silver acetylides - Chemical reactions
848
Silver bromide crystals - Hall effect
889, 890
Silver bromide crystals - Scattering
889
Silver bromide crystals - Thermoelectric properties
890
Silver chloride crystals - Crystal structure
1849
Silver crystals - Deformation
881
Silver crystals - Diffusion
461
Silver crystals - Fermi surface
165, 167, 402, 403
Silver crystals - Surface properties
2935
Silver crystals - Ultrasonic analysis
165-167
Silver electrodes - Electrochemistry
1652
Silver halide crystals - Hall effect
892
Silver halide crystals - Purity
895
Silver halide crystals - Scattering
892
Silver halide crystals - Zone refining
895
Silver nitrate - Crystal structure
1326
Silver nitrate - Thermodynamics
2337
Silver salts - Electron spin resonance
1929
Silver-tungsten alloys - Crystal structure
559
Silver-tungsten crystals - Crystal structure
559
Single crystals - Conductivity
1343
Single crystals - Crystal structure
559, 1849
Single crystals - Deformation
1895, 2437
Single crystals - Dielectric properties
1752
Single crystals - Diffusion theory
460, 461
Single crystals - Dislocations
1666
Single crystals - Elastic constants
1602
Single crystals - Electrical properties
1663, 1667, 1670
Single crystals - Electrodes
2135
Single crystals - Electron mobility
892
Single crystals - Electron spin resonance
641
Single crystals - Fracture
321
Single crystals - Growth
87-89, 813, 2915-2918, 2931-2934
Single crystals - Internal friction
565
Single crystals - Nuclear spin resonance
293
Single crystals - Optical properties
1663, 1664, 1668, 1669
Single crystals - Paramagnetic resonance
803-805
Single crystals - Phase transitions
1902
Single crystals - Production
1352
Single crystals - Rotation
2537
Single crystals - Spectra
2121, 2126
Single crystals - Structure
88, 755, 1710, 1712
Single crystals - Thermodynamics
2141
Single crystals - Ultrasonic analysis
162, 164-167
Single crystals - X-ray diffraction analysis
851
Single crystals (Metallurgy) - Deformation
685
Single crystals (Metallurgy) - Fatigue
130
Single crystals (Metallurgy) - Temperature factors
1901

Sintering - Kinetic analysis
1609, 1610
Skin - Electrical stimulation
951
Skin - Sensitivity
188, 1073, 1435, 1458
Skin - Stimulation
1458
Sleep - Abnormal psychology
1567
Sleep - Driving conditions
723
Sleep - Electroencephalographic analysis
2110
Sleep - Mechanisms
723
Sleep - Test methods
127
Sleep (Cat) - Electroencephalographic analysis
722
Small group research - Bibliography
829, 831
Social behavior - Theory
1774
Social sciences - Language analysis
1775
Social sciences - Test methods
1771
Sodium - Specific heat
1219
Sodium azide - Chemical reactions
598
Sodium borohydrides - Reaction kinetics
474
Sodium chloride - Electric fields
1457
Sodium chloride - Reaction kinetics
62
Sodium chloride - Vaporization
1900
Sodium hydroxide - Molecular beams
491
Sodium hydroxide - Vapors
491
Sodium iodide crystals - Spectra
1828, 2010
Sodium ions - Hyperfine coupling
2896
Sodium ions - Nuclear resonance
1706
Sodium ions - Nuclear spins
1706
Sodium ions - Spectra
2896
Sodium molybdate - Crystal structure
2810
Soils - Drainage
607, 609, 610
Soils - Strontium distribution
606, 607, 609, 610
Solar atmosphere - Spectrographic analysis
2615
Solar corona - Dynamics
1958
Solar corona - Measurement
1180
Solar corpuscular stream - Satellite observations
1179
Solar flares - Intensity
2458
Solar flares - Particle acceleration
451
Solar radiation - Satellite observations
1179
Solar spectrum - Analysis
2614, 2619
Solar spectrum - Microwave spectroscopy
2610
Solar spectrum - Resonance
221
Solar spectrum - Spectrographic analysis
221
Solar systems - Synthesis of elements
897
Solid propellants
see also Propellants
Solid propellants - Binders
16
Solid propellants - Combustion
27, 32, 72, 1104, 2207, 2209, 2501
Solid propellants - Decomposition
32
Solid propellants - Detonation
32
Solid propellants - Erosive burning
690
Solid propellants - Ignition
2208
Solid propellants - Oxidizers
16
Solid state physics - Crystallography
1327-1329
Solid state physics - Mathematical analysis
1930-1932
Solids - Color centers
49
Solids - Combustion
32
Solids - Decomposition
28, 32, 2945
Solids - Detonation
32
Solids - Diffusion
49, 459, 2253
Solids - Electronic structure
574
Solids - Heat transfer
1340, 2518
Solids - Ionic conduction
49
Solids - Luminescence
2499
Solids - Mechanical properties
1753
Solids - Molecular scattering
320
Solids - Optical properties
459, 803

Subject Index

Solids - Photolysis
235
Solids - Reaction kinetics
28
Solids - Resonance spectra
1188
Solids - Specific heat
1236
Solids - Stresses
2518, 2519
Solids - Sublimation
28
Solids - Surface properties
571, 2499
Solids - Thermodynamic properties
1911
Solids - X-ray analysis
574, 1326
Solubility - Measurement
47, 2013
Solubility - Qualitative analysis
2430
Solubility - Test equipment
2430
Solutions - Electrochemistry
752, 1039
Solutions - Magnetic resonance
2745
Solutions - Metal ion levels
1841
Solutions - Physical properties
2745
Solutions - Polarograms
1939
Solutions - Spectrographic analysis
2745, 2896
Solutions - Thermal conductivity
1065
Solvents - Carbon alkylation
2291
Solvents - Chemical effects
1768
Solvents - Chemical reactions
964
Solvents - Ionic mixtures
2335
Solvents - Properties
2985-2987
Sound - Noise source
2770, 2776
Sound - Propagation
769, 1518
Sound - Scattering
1486, 1574
Sound scattering - Mathematical analysis
1486
Sound scattering - Turbulence
1574
Sound transmission - Determination
1518
Sound transmission - Mathematical analysis
751, 769
Sound transmission - Temperature factors
969
Space activities - Cold war
522
Space charges - Energy
2602, 2608
Space flight - Human engineering
334
Space flight - Physical chemistry
2071
Space Flight - Symposium
2071
Space perception - Mathematical analysis
2660
Space perception - Stimulation
2660
Space perception - Test methods
188, 2660
Space probes - Cosmic rays
445, 446, 452
Space propulsion - Electromagnetic properties
2360
Spacecraft Surface Effects - Symposium
44
Spaceships - Drag
2155
Spaceships - Lift
2155
Spaceships - Molecular flow
2219, 2223
Spaceships - Propulsion
2354
Special functions
see also separate Mathematical Subject Classification, p. 903
Special functions - Errors
1511
Specialized Heart Tissues - Symposium
149
Specific heat - Determination
1236, 1504
Specific heat - Measurement
1504
Specific heat - Temperature factors
2518
Spectrographic analysis - Applications
926, 1438, 1745, 2182, 2825
Spectrographic analysis - Instrumentation
2835
Spectrographs - Design
2958
Spectroheliograms - Analysis
2615
Spectrometers - Analysis
2533
Spectrometers - Application
21, 2589, 2591
Spectrometers - Design
2583, 2589
Spectrometers - Operation
2121, 2583
Spectroscopy - Applications
2950
Spectroscopy - Instrumentation
2958

Spectroscopy - Techniques
926
Spectroscopy - Theoretical analysis
1622
Spectrum analyzers - Design
21, 729, 734
Spectrum analyzers - Masers
485, 486
Speech - Analysis
1485, 1522-1525, 1637
Speech - Identification
1637
Speech - Mathematical analysis
1475
Speech - Perception
1636
Speech - Phonemic analysis
1635
Speech recognition - Instrumentation
1451, 1467
Speech representation - Analysis
1635
Speech representation - Perception
1636
Spheres - Fluid flow
3043
Spheres - Mathematical analysis
751, 1257
Spheres - Potential theory
1256
Spheres - Preparation
2948
Spheres - Reflective effects
1254
Spheres - Stresses
2149
Spheres - Supersonic flow effects
1829
Spherical shells - Deformation
2148, 2150
Spin coupling - Spectrographic analysis
1547
Spin relaxation - Measurement
296
Spin resonance - Mathematical analysis
2297
Spin resonance - Optical factors
1646
Spin resonance - Parity
2296
Springs - Deformation
2525
Stable isotopes - Electron scattering
2574, 2584
Stars - Analysis
2822
Stars - Beryllium abundances
223
Stars - Corona
226
Stars - Hydrogen abundances
231
Stars - Lithium abundances
220, 222
Stars - Magnetic fields
218
Stars - Metal abundances
217, 219, 224, 228, 2401
Stars - Neutron sources
227
Stars - Oscillatory properties
1551
Stars - Physical parameters
251
Stars - Radiation
2452
Stars - Spectrographic analysis
217, 219, 220, 222-224, 229
Stars - Surface temperatures
229
Stars - Theory
226, 701
Statistical analysis
see also separate Mathematical Subject Classification, p. 903
Statistical analysis - Applications
1867-1869, 1871
Statistical distribution
see also separate Mathematical Subject Classification, p. 903
Statistical distribution - Applications
1856
Statistical mechanics - Mathematical analysis
183, 417, 418, 422, 1811, 1815, 1816
Statistical models - Theory
1388
Statistical tests - Applications
1860
Statistics
see also separate Mathematical Subject Classification, p. 903
Statistics - Categorical data
1970
Steam - Viscosity
174
Stearic acid - Molecular structure
1144
Steel - Aging
1905
Steel - Fracture (Mechanics)
525
Steel - Internal friction
1898
Stereochemistry
2016, 2293, 2471, 3035
Steroids - Homeostatic variation
1963
Sterols (Chicken) - Biosynthesis
866
Sterols (Chicken) - Steric acid properties
866
Stibnite - Electrical properties
1091, 1092
Stibnite - Switching effect
1091
Stilbestrol - Physiological effects
1570

Subject Index

Stimulation - Habituation
2113, 2114
Stimulation (Rabbit) - Perception
2112
Strain - Mathematical analysis
2709
Strain - Measurement
2708
Stress analysis - Test methods
1607, 1608
Stress analysis - Theory
395, 602, 2521-2523
Stresses - Deformation
1562
Stresses - Hypersonic flow
78
Stresses - Mathematical analysis
352-354, 524, 524A, 539, 540, 618, 619, 874, 1109, 1257, 1319, 1581, 1802, 1804, 1897, 2148, 2150, 2346, 2347, 2704, 2708, 2709, 2711, 2714
Stresses - Measurement
2338
Stresses - Theory
1897
Stresses - Thermodynamics
2018
Stresses (Physiology) - Hormones
794
Stresses (Physiology) - Test methods
623, 624
Strong Interactions - Symposium
60
Strontium (Radioactive) - Determination
606, 607, 609, 610
Strontium compounds - Conductivity
1347
Strontium distribution - Hydrology
606, 608, 609
Strontium ions - Physical effects
1070
Strontium isotopes - Atomic mass
1138
Structural shells - Deformation
1299
Structural shells - Stresses
1298
Structures - Computer analysis
2067
Structures - Deformation
2149, 2523
Structures - Stability
2713
Structures - Stresses
2521-2523, 2713, 2714
Structures - Temperature factors
2522
Structures - Thermal stresses
2146
Strychnine - Physiological effects
1077
Subject indexing - Data analysis
2971
Sublimation - Kinetics
1900
Subsonic flow - Mathematical analysis
2420, 2421
Substitution reactions - Acid catalysis
1766-1768
Sulfates - Crystal structure
2429
Sulfide compounds - Molecular structure
1951
Sulfinyl radicals - Chemical reactions
1087
Sulfinyl radicals - Molecular structure
1088
Sulfur - Diffusion
2249
Sulfur - Metabolic studies
1110
Sulfur (Radioactive) - Application
1112
Sulfur dioxide - Molecular beams
1556
Sulfur dioxide - Relaxation time
2198
Sulfuric acid - Additional reaction
1954
Sun - Lead abundances
225
Sun - Mapping
2615
Sun - Spectrographic analysis
225
Superaerodynamics
2136-2138, 2433-2436
Superaerodynamics - Gas flow
1576, 2773
Superaerodynamics - Thermodynamics
2772
Superconductivity - Magnetic factors
2942
Superconductivity - Theory
2938, 2939
Superconductors - Magnetic fields
1754
Superconductors - Thermodynamics
1504
Supersonic flow - Analysis
9
Supersonic flow - Boundary layer
2739
Supersonic flow - Heat transfer
2482
Supersonic flow - Interference
35-39
Supersonic flow - Laminar boundary layer
2780, 2781
Supersonic flow - Mathematical analysis
106, 169, 170, 181, 310, 2142, 2710, 2732-2738
Supersonic flow - Pressure
924
Supersonic flow - Production
10
Supersonic flow - Separation
2782
Supersonic flow - Stability
2734

Supersonic flow - Temperature
924
Supersonic wind tunnels - Detonation waves
647
Supersonic wind tunnels - Mathematical analysis
310
Supersonics - Experimental data
1829
Suprarenal medulla (Rabbit) - Catechol amines
1123
Surface catalysis - Oxygen systems
2342
Surface reactions - Atomic recombination
2000, 2194, 2195, 2199, 2200
Surface reactions - Inhibition
1748
Surface resistance - Measurement
2201
Surfaces - Atomic adsorption
712
Surfaces - Catalytic properties
6, 7
Surfaces - Diffusion
2194
Surfaces - Electron reactions
2026
Surfaces - Heat resistant
348
Surfaces - Heat transfer
177, 178
Surfaces - Ion production
22
Surfaces - Ion repulsion
2473
Surfaces - Molecular scattering
312, 320
Surfaces - Optical transparency
348
Surfaces - Reaction kinetics
6, 7
Surfaces - Tension properties
2474
Surfaces - Theory
2212
Surfaces - Thermodynamic properties
1611, 2519
Surgery - Stereotaxic methods
2107
Switching circuits - Design
2173, 2639
Switching circuits - Mathematical analysis
2172, 2639
Switching circuits - Resistors
2649
Switching circuits - Synthesis
912
Switching circuits - Theory
912
Switching effect - Electric field factors
1091
Switching effect - Time factors
1091
Symmetry (Crystallography) - Mathematical analysis
2265
Symposia - Active networks and feedback systems
2179
Symposia - Airbreathing combustion
303
Symposia - Astronautics
43
Symposia - Chemical kinetics of propulsion
707
Symposia - Cold acclimation
648
Symposia - Color centers and crystal luminescence
991
Symposia - Combustion
526, 527
Symposia - Combustion of solid propellants
72
Symposia - Comparative bioelectrogenesis
148
Symposia - Electrical conductivity organic solids
613
Symposia - Electrode processes
646
Symposia - Fermi surface of metals
713
Symposia - Gas dynamics
1881
Symposia - High energy physics
2412
Symposia - High temperature technology
2500
Symposia - Ion and plasma propulsion
2354
Symposia - Liquid propellant rocket combustion
2309
Symposia - Low pressure aerodynamics
2779
Symposia - Magneto-fluid dynamics
1758
Symposia - Mathematical statistics
250
Symposia - Millimeter waves
2180
Symposia - Mössbauer effect
884
Symposia - Non-crystalline solids
1762
Symposia - Nuclidic masses
1141
Symposia - Penetration of charged particles in matter
1759
Symposia - Physical chemistry in aerodynamics and space flight
2071
Symposia - Plasma dynamics
1761
Symposia - Probability
250
Symposia - Problems related to interplanetary matter
1763
Symposia - Quantitative biology
1114
Symposia - Quantum chemistry
2415

Subject Index

Symposia - Rare earth research
231
Symposia - Semiconductor nuclear particle detectors
1760
Symposia - Sensory communication
1420
Symposia - Space flight
2071
Symposia - Spacecraft surface effects
44
Symposia - Specialized heart tissues
149
Symposia - Strong interactions
60
Synthesis - Biochemical mechanisms
2984
Synthesis - Mechanisms
1883, 2475
Systems research - Bibliography
2786

Tactual perception - Measurement
188
Tactual perception - Stimulation
1633
Tantalum - Superconductivity
1504
Tantalum electrodes - Electrochemistry
1655
Tantalum isotopes (Radioactive) - Decay
2577
Tantalum-hydrogen systems - Thermodynamics
850
Taylor's series - Applications
1858
Technetium - Hyperfine structure
817
Technetium - Paramagnetic resonance
817
Teflon - Applications
2666
Teflon - Lubricant
216
Telescopes - Applications
2455, 2456
Tellurium - Crystal structure
1663, 1665, 1669
Tellurium - Recombination processes
1664
Tellurium compounds - Crystal structure
1356
Tellurium crystals - Dislocations
1666
Tellurium crystals - Electrical properties
1663, 1667, 1670
Tellurium crystals - Optical properties
1663-1665, 1668, 1669
Temperature - Control
12, 1555
Terbium (Radioactive) - Decay
818
Terrestrial magnetism - Analysis
1222, 2154
Terrestrial magnetism - Electromagnetic effects
2479
Test equipment (Mechanics) - Design
2526
Tetrachlorobenzene - Molecular structure
2127
Tetrachlorofulvenes - Chemical reactions
475
Tetrachlorofulvenes - Stability
475
Tetrahydrofuran - Infrared spectra
193
Tetrahydrofuran solution - Spectrographic analysis
2896
Tetramethylammonium ozonide - Properties
842
Tetramethylammonium ozonide - Synthesis
842
Tetramethylsilane - Thermodynamic properties
193
Tetramethylthiourea - Synthesis
597
Tetramethylthiuram sulfide - Synthesis
597
Tetrapenyltetrazene - Reaction kinetics
198
Tetrazine - Spectra
2901-2903
Textbooks
1203
Thallium - Thermal vibrations
67
Thallium isotopes (Radioactive) - Decay
2814
Thallium isotopes (Radioactive) - Hyperfine structure
1537
Thallium isotopes (Radioactive) - Isotope shift
1537
Thallium isotopes (Radioactive) - Transition energies
2814
Thermal diffusion - Mathematical analysis
718
Thermal ionization - Saha equations
8
Thermal ions - Production
733
Thermal radiation - Mathematical analysis
1339, 1540
Thermal radiation - Measurement
1497
Thermal radiation - Sources
1497
Thermal radiation - Tables
2524
Thermal stresses - Analysis
2518
Thermal stresses - Mathematical analysis
134-136, 617, 618, 704, 2018, 2019, 2146, 2519, 2520, 2740
Thermal stresses - Temperature factors
704
Thermal stresses - Theory
2019

Thermionic emission - Properties
1512, 1832
Thermionic emitters - Thoriated filament
733
Thermobalance - Design
2747
Thermodynamics
see also the subdivision, e.g., Chemical reactions - Thermodynamics
Thermodynamics - Mathematical analysis
1212, 1814
Thermodynamics - Phase studies
1330
Thermodynamics - Statistical analysis
422
Thermodynamics - Theory
1330
Thermoelasticity - Mathematical analysis
617, 1679, 2520
Thermoelasticity - Stresses
524, 2520
Thermoelectric properties - Mathematical analysis
873
Thermoelectricity - Theory
1136
Thermometers - Catalytic probe
9
Thermometry - Nuclear quadrupole resonance method
2123
Thermonuclear reactions - Mathematical analysis
2353
Thiatriazoles - Chemical properties
599
Thiatriazoles - Synthesis
598, 599
Thin films - Aging properties
2473
Thin films - Ferromagnetic resonance
1675
Thin films - Physical properties
2177
Thin films - Preparation
2917, 2933
Thin films - Thickness
568
Thiodiglycolic acid - Electron spin resonance
642
Thiodiglycolic acid - Free radical structure
642
Thiols - Chemical reactions
2016
Thiols - Infrared spectra
193
Thiols - Synthesis
597
Thiophene isotopes (Radioactive) - Preparation
535
Thiophenes - Isotopic labeling
535
Thiophenes - Molecular structure
536
Thiophosgene - Chemical reactions
598
Thorium perchlorate - Chemical reactions
1713
Thorium perchlorate - Dissociation
1713
Thrust bearings - Instrumentation
2707
Thulium isotopes - Hyperfine structure
273
Thyroid glands - Biological assay
99, 100, 102
Thyroid glands - Hormonal stimulation
1571
Thyroid glands - Iodine uptake
1894
Thyroid glands - Stimulation
1078
Thyroid hormones - Secretion
1078
Thyrotrophic hormones - Biological assay
1573
Thyrotrophic hormones - Physiological effects
1571
Tin - Cyclotron resonance
279
Tin - Superconductivity
1504
Tin compounds - Properties
787-789
Tin crystals - Fermi surface
166
Tin crystals - Phase transitions
1902
Tin crystals - Structure
164
Tin crystals - Ultrasonic analysis
162, 164, 166
Tissue extracts - Chromatography
1893
Titanates - Thermoelectric properties
873
Titanium - Crystallization
680
Titanium - Emission spectra
207
Titanium - Mechanical properties
680
Titanium - Oxidation
1143
Titanium - Purification
679, 680
Titanium - Tensile properties
679
Titanium compounds - Dielectric properties
1752
Titanium compounds - Mechanical properties
1753
Titanium compounds - Physical properties
2807
Titanium dioxide - Sintering
1610
Titanium dioxide crystals— Growth
1610
Titanium electrodes - Electrochemistry
1653

Subject Index

Titanium isotopes - Neutron threshold
670
Titanium oxide - Conductivity
1343
Titanium oxide - Field emission
1343
Toluenethiol - Stereochemistry
2292
Tolylmercaptocinnamic acid - Synthesis
2292
Topology
see also separate Mathematical Subject Classification, p. 903
Topology - Applications
2171
Torque - Determination
402, 403
Torque - Measurement
1350
Tracer studies - Mathematical analysis
1069
Trachea (Mammalian) - Gaseous ion effects
331, 332
Tracking - Anticipated responses
900
Tracking - Bisensory stimulation
901
Tracking - Factor analysis
899
Tracking systems - Mathematical analysis
922
Traffic - Statistical processes
1242
Transducers - Applications
1436
Transducers - Synthesis
2168
Transformations
see also separate Mathematical Subject Classification, p. 903
Transformations (Mathematics)
1609
Transformations (Mathematics) - Particle distribution
2404
Transformations (Mathematics) - Properties
2218
Transients - Mathematical analysis
750
Transistors - Applications
2571
Transistors - Circuits
2644, 2645
Transistors - Mathematical analysis
2646
Transition elements - Crystal structure
2796
Transition elements - Phase studies
850
Transition elements - Properties
2795
Transition metal alloys - Oxide films
399
Transitions (Second-order) - Mathematical analysis
1538
Transmission lines - Design
2168
Transmission lines - Microwaves
1463
Transmission lines - Theory
749
Transonic flow
see also Hypersonic flow; Supersonic flow
Transonic flow - Mathematical analysis
179-181, 2420
Transonic flow - Pressures
924
Transonic flow - Temperatures
924
Transport mechanisms - Theory
184
Traveling wave tubes - Containers
2632
Traveling wave tubes - Design
905, 2175
Traveling wave tubes - Noise
295
Traveling wave tubes - Operation
1917, 2637
Triangular wings - Aerodynamic characteristics
2740
Trifluorobromoethylene - Photochemical reactions
476
Trifluorobromoethylene - Photo halogination
476
Trigger circuits - Theory
2644
Trimethylaluminum - Thermodynamic properties
196
Triselhylenedianiine platinum anion complexes - Molecular association
562
Tritons - Production
448
Trypsin - Chemical reactions
2937
Trypsin - Preparation
2937
Tubes - Turbulent flow
1628, 2423, 2424
Tungstates - Scintillation properties
1594, 1596
Tungsten - Alpha decay
1594
Tungsten - Decay
1596
Tungsten - Diffusion properties
22
Tungsten - Surface properties
712
Tungsten - Thermal vibrations
67
Tungsten oxides - Crystal structure
559
Turbine blades - Friction drag
1331
Turbulence - Computer analysis
2767

Turbulence - Mathematical analysis
507, 1277, 1604
Turbulence - Measurement
1574
Turbulent boundary layer - Compressible flow
1416
Turbulent boundary layer - Heat transfer
175, 1416
Turbulent boundary layer - Incompressible flow
582
Turbulent boundary layer - Mathematical analysis
416
Turbulent boundary layer - Phase transitions
1276
Turbulent boundary layer - Shock waves
2210
Turbulent boundary layer - Theory
2139
Turbulent flow - Analysis
1261
Turbulent flow - Mathematical analysis
1736, 1755
Turbulent flow - Phase studies
1628
Turbulent flow - Stresses
1628
Turbulent flow - Velocity distributions
1628
Typewriters - Design
3046
Tyramine - Physiological effects
1074

Ulcer patients - Catechol amine excretion
1290
Ultrasonic radiation - Attenuation
162-168
Ultrasonic radiation - Chemical effects
155
Ultrasonic radiation - Magnetic factors
164
Ultraviolet light - Source
2952
Ultraviolet radiation— Applications
1186, 1187
Ultraviolet radiation - Measurement
2416
Ultraviolet spectra - Analysis
1088
Ultraviolet spectroscopy - Applications
1064, 1612
Ultraviolet spectroscopy - Instrumentation
2910
Univalent ions - Electron spin resonance
1715
Upper atmosphere - Aircraft detection
2129
Upper atmosphere - Electromagnetic properties
2621, 2622, 2624-2631
Upper atmosphere - Ionization
2627
Upper atmosphere - Properties
1179-1181
Upper atmosphere - Radiation
1223
Urease - Crystallization
1941, 1942

Vacuum systems - Design
1831
Vacuum systems - Glass design
23
Vacuum systems - Ion acceleration
1831
Vacuum systems - Test methods
94
Vacuum technology
1440, 1453, 2134
Van de Graaff generator - Ionized particles
2829
Vanadium compounds - Spectra
2532
Vanadium ions - Zero field splitting
811
Vanadium isotopes - Stripping properties
1364
Vanadium-hydrogen systems - Thermodynamics
850
Vanadyl ions - Spectra
2532
Vaporization - Kinetics
1900
Vapors - Thermodynamic properties
420
Variance analysis - Applications
1867, 1868, 1873
Variable resistors - Performance
2649
Vasopressin - Biosynthesis
2977
Vasopressin - Blood content
2976
Vehicles - Moving traffic
1242
Velocity - Instrumentation
604
Velocity - Measurement
604
Velocity - Perception
2658
Verbal behavior - Test methods
2862-2864
Vibration - Damping
2525
Vibration - Mathematical analysis
2165-2167, 2343-2347, 2525
Vibration (Molecules) - Ionic potentials
726
Vibration (Molecules) - Mathematical analysis
725, 726
Vibrational relaxation - Measurement
2202
Vinyllithium - Spectra
1552
Viscoelasticity - Theory
1579, 1581, 1582

Subject Index

Viscosimeters - Design
172, 173
Viscosimeters - Performance
172, 173
Viscosity
see also as a subdivision, e.g., Gases - Viscosity
Viscosity - Measurement
171-174, 548
Viscous flow - Boundary layer
2143
Viscous flow - Mathematical analysis
719, 1779, 1780, 2222
Viscous flow - Optimal coordinates
2328
Vision - Effects of motion
998
Vision - Illumination
993, 998, 1000, 1014, 1015
Vision - Image perception
2837
Vision - Physiological factors
1151, 1167, 1169, 1421, 1422
Vision - Psychological factors
1875
Vision - Research
1009
Vision - Test methods
2244
Vision (Cat) - Perception
2115
Vision (Cat) - Stimulation
1161
Vision (Octopus) - Form discrimination
1105
Vision (Octopus) - Light discrimination
1106
Vision (Octopus) - Physiological factors
1105, 1106
Visual acuity - Test methods
391, 993, 995, 997, 1001, 1002, 1004-1007, 1009, 1015
Visual cortex (Cat) - Response
2106
Visual cortex (Cat) - Stimulation
2106
Visual perception - Measurement
1002, 1007, 1161
Visual perception - Physical factors
994, 996, 1013, 1014
Visual perception - Physiological factors
998, 1004
Visual perception - Psychophysical factors
2659
Visual perception - Stimulation
2659
Visual perception - Test methods
899, 1000, 2659
Visual perception - Theory
997, 1422, 1423
Visual perception (Rabbit) - Physiological factors
1079
Visual responses - Analysis
954, 955
Visual responses - Stimulation
954, 955
Visual system - Electroencephalographic analysis
2110
Visual thresholds - Measurement
1000, 1014, 2244
Visual thresholds - Physical factors
1007, 1013
Vitamin K - Spectra
2514
Voltage clamps - Physiological applications
2823
Volumetric analysis - Titration
1064
Vortices - Mathematical analysis
2321, 2739
Vortices - Motion
33, 34, 1278, 1279, 2769

Wake - Mathematical analysis
2143
Warfare - Evasion
1906
Water - Molecular structure
1085, 1086
Water - Physical properties
2445
Water systems - Relaxation time
1920
Water tanks - Boundary layer control
528
Water waves - Scattering
857
Wave functions - Analysis
2954, 3020
Wave functions - Deformation
3014, 3019
Wave mechanics - Orbital functions
408, 410, 468, 469, 471-473
Wave propagation - Mathematical analysis
2174, 2603
Wave transmission - Analysis
2467, 2468
Wave transmission - Velocity
1314, 1602
Waveguides - Analysis
1463, 2467
Waveguides - Couplers
1463
Waveguides - Dielectric properties
2174
Waveguides - Electromagnetic properties
2183
Waveguides - Mode coupling
1500
Waveguides - Propagation
1500, 2174
Waveguides - Windows
2601
Wedges - Aerodynamic characteristics
315
Wedges - Subsonic characteristics
2421, 2422

Welding - Friction
2339
Whistlers - Applications
2626
Whistlers - Properties
2621, 2622, 2624, 2626-2631
Wind tunnel models - Design
1417
Wind tunnel models - Performance
107
Wind tunnel nozzles - Boundary layer thickness
2481
Wind tunnels
see also Hypersonic wind tunnels; Supersonic wind tunnels
Wind tunnels - Pressure equipment
2480
Wing-body interference - Mathematical analysis
35-39
Wings - Aerodynamic characteristics
107, 169, 170
Wings - Flutter
104
Wings - Interference
35-39
Wings - Lift
586, 587
Wings - Supersonic characteristics
35-39
Wings - Thermal stresses
2740
Wire - Heat transfer
1320, 1325
Wire - Impedance
1597
Wollaston prism - Spectral polarization
66
Writing - Analysis
1510

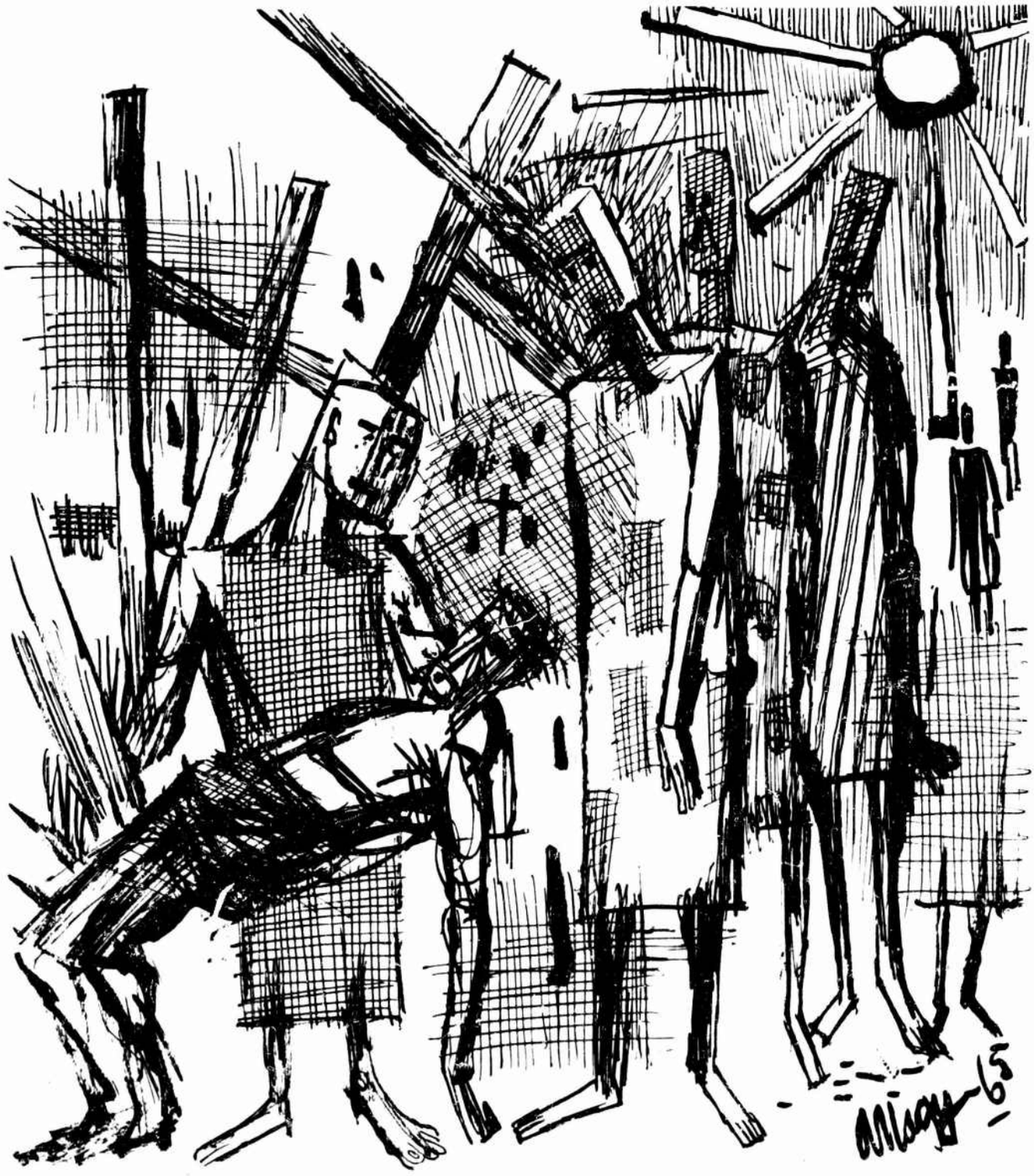
X-ray analysis - Polarization direction
2069
X-ray diffraction analysis - Apparatus
852, 1067
X-ray diffraction analysis - Applications
324, 754-756, 853, 989, 990, 1592, 1835, 1836, 1903, 2001, 2140, 2250, 2697, 2797, 2798, 2816, 2817, 2905
X-ray diffraction cameras - Furnaces
737
X-ray microscopy - Applications
1067
X-ray spectroscopy - Applications
574, 1455
X-rays - Meson capture
254
Xenon - Magnetic properties
2445
Xenon - Nuclear magnetic resonance
2443

Yeasts - Enzyme activity
2983
Yeasts - Enzyme synthesis
2982
Yeasts - Protein synthesis
2982
Ytterbium crystals - Paramagnetic resonance
804
Yttrium iron garnet - Properties
2597
Yttrium isotopes - Hyperfine structure
274
Yttrium isotopes - Nuclear moments
274
Yttrium isotopes (Radioactive) - Polarization
2890

Zinc - Specific heat
1553
Zinc compounds - Photochemical reactions
52, 54
Zinc crystals - Creep
1896
Zinc crystals - Diffusion paths
854
Zinc crystals - Dislocations
682
Zinc crystals - Etching
681
Zinc crystals - Fatigue
130
Zinc crystals - Growth
682
Zinc crystals - Impurities
682
Zinc crystals - Microphotographic analysis
681
Zinc crystals - Structure
681, 682
Zinc fluorides - Paramagnetic resonance
808
Zinc isotopes - Decay
676
Zinc isotopes - Electron transitions
676
Zinc isotopes - Nuclear energy levels
676
Zinc oxide crystals - Electron density
853
Zinc oxide crystals - X-ray diffraction analysis
853
Zinc oxides - Adsorption properties
52, 54
Zinc oxides - Photochemical reactions
52, 54
Zinc silicates - Paramagnetic resonance
808
Zinc sulfides - Adsorption properties
52, 54
Zinc sulfides - Photochemical reactions
52, 54

Subject Index

Zirconium - Oxidation
1143
Zirconium - Purification
679
Zirconium - Tensile properties
679
Zirconium electrodes - Electrochemistry
1655
Zirconium isotopes - Atomic mass
1138
Zone refining apparatus - Design
676



Mathematical Subject Classification

ALGEBRA

Algebras:
- Non-associative algebras
  1593

Combinatorial Analysis
  2171
- Magic squares, block designs, configurations
  1857

Fields, Rings:
- Rings
  1890

Fields and Polynomials:
- Differential algebra
  796, 798, 801

Groups and Generalizations:
- Abelian groups
  3006
- Applications
  426
- Matrix groups, representation, characters
  974, 1864, 2867

Linear Algebra:
  1301
- Forms and transformations
  151-153, 2375, 2390
- Location of eigenvalues and eigenvectors
  1798
- Matrices
  3, 150-153, 1149, 1842, 2075

Non-associative Rings and Algebras:
- Jordan rings and algebras
  3000, 3008, 3009

Polynomials:
- Algebraic equations, roots
  280

FOUNDATIONS, THEORY OF SETS, LOGIC

Applications of Logic
  2349

Foundations of Mathematics
  1771

Set theory
  654, 1686.

GEOMETRY

Algebraic Geometry:
- Abelian, equivalence theories
  247
- General theory of curves
  765

Convex Domains, Distance Geometries:
- Convex sets and geometric inequalities
  795, 935, 938, 939

Differential Geometry:
  1032
- Convex surfaces with no bending
  1095
- Kählerin manifolds
  2920, 2921
- Riemannian manifolds
  2921

Geometries, Euclidean and Other:
- Conics, quadric surfaces
  342
- Minkowski geometry
  940

Manifolds, Connections:
- Non-Riemannian geometry, conformal, spray, affine, projective connections
  1295
- Riemannian geometry
  1293, 1294, 1311

LOGIC AND FOUNDATIONS

Recursive Function Theory, Turing Computability
  2077

MATHEMATICAL ANALYSIS

Approximations and Expansions:
- Biorthogonal systems
  1672
- Degree of approximation, best approximation
  2676-2679
- Orthogonal systems, expansions
  2475
- Polynomial approximation
  759-761, 763, 764

Calculus of Variations:
- Theory in the large, topological methods
  1698

Difference Equations, Functional Equation
- Finite differences and difference equations
  282, 358, 2733, 2737
- Functional equations
  1113

Differential Equations
  2228

Differential Equations: Ordinary
- Boundary value problems
  1026, 1765
- Boundary value problems, properties of eigenfunctions
  2281
- Eigenvalues, eigenfunctions
  2705
- Eigenvalues, reciprocals
  2706
- Linear equations: second order
  1031
- Linear equations: other than second order
  1031
- Non-linear oscillations
  2363
- Other qualitative and topological properties
  2383
- Periodicity, almost periodicity
  2377
- Periodicity, oscillations
  288, 1307, 2364, 2372

Mathematical Subject Classification

MATHEMATICAL ANALYSIS (cont'd)

- Perturbations
  - 1198
- Special types
  - 364, 1027, 1030, 1730, 1782, 2389, 2375
- Stability
  - 2381, 2388, 2371, 2374
- Stability of autonomous systems
  - 2382
- Stability of solutions
  - 1028
- Uniqueness
  - 1255

Differential Equations: Partial
- 1175, 2530, 2785
- Approximate methods
  - 1247, 2157
- Cauchy problem
  - 1249
- Eigenvalues, eigenfunctions
  - 244, 248, 797, 1245, 1252
- Elliptic equations, boundary value problems
  - 244, 245, 397, 433-435
- Elliptic first-order systems
  - 758
- Existence and uniqueness
  - 1029, 1031, 1255, 1260, 1728
- First-order equations
  - 275, 509
- General second-order linear and quasi-linear equations
  - 2923
- Hyperbolic equations
  - 934, 1250, 1255
- Hyperbolic equations, Cauchy problem
  - 242, 243, 1098, 1099
- Hyperbolic second-order equations
  - 237, 946, 2237
- Mixed equations
  - 245, 2924
- Non-linear equations, special types
  - 297, 438, 539, 937, 1176, 1177, 1247, 1506, 1728, 1790, 2182, 2370
- Parabolic equations
  - 936, 1673, 2151
- Uniqueness
  - 1174

Fourier Analysis:
- 2441
- Abstract harmonic analysis
  - 1888, 1889
- Convergence, summability
  - 530, 2439, 2716, 3002
- Fourier integrals
  - 1887
- Trigonometric interpolation
  - 531

Functional Analysis
- 1683, 2370, 2668
- Algebras
  - 3004
- Applications of functional analysis; analysis of differential and integral operations
  - 943, 944
- Banach algebras of analytic functions
  - 800, 802, 1884, 1885, 2294, 2295, 2507, 3003
- Communitative algebras
  - 3001
- Hilbert spaces
  - 2278, 2280
- Perturbation theory
  - 2279
- Relations among several linear operators
  - 2277
- Topological linear spaces
  - 2440
- von Neumann algebras
  - 1318

Functions of Complex Variables
- 1619
- Conformal mapping, special problems
  - 436, 704, 762
- Entire functions, functions of exponential type
  - 867, 888, 947, 949
- Functions of several complex variables
  - 2229, 2230
- Meromorphic functions
  - 2674, 2675
- Normal families
  - 478
- Power series
  - 1318, 2848
- Riemann-Hilbert problem
  - 1307
- Riemann surfaces and functions on them
  - 1310, 1311, 1688, 1689
- Several complex variables
  - 2235
- Singularities
  - 378, 388
- Zeros
  - 867, 888

Functions of Real Variables:
- Differentiation and tangents
  - 2379
- One real variable
  - 433
- Several variables
  - 1697

Harmonic Functions, Convex Functions:
- Harmonic functions, potential theory
  - 396

Integral Equations
- 2708

Integral and Integrodifferential Equations
- 1197
- Linear integral equations
  - 317
- Singular integral equations
  - 1307
- Special integral equations
  - 1811

Integral Transforms
- 1060, 1671

MATHEMATICAL ANALYSIS (cont'd)

Fourier transforms
1178
Laplace and Fourier transforms
290, 616, 1058, 1059, 2438
Other transforms, Hilbert, Mellin, Hankel
614, 1809
Operational Calculus
2715
Integral Transforms and Operational Calculus:
Convolutions
2869
General transforms
1886, 2865, 2866
Hilbert transforms
1887
Laplace transform, Stieltjes transform
283
Measure, Integration:
2630, 2681
Abstract theory of probability
2669
Area length
2275
Measure-preserving transformations, ergodic theorems
2389
Measure theory
2395, 3007
Potential Theory:
Harmonic functions, general
1919
Harmonic functions in the plane
2394
Sequences, Series, Summability
2020, 3047
Convergence and summability
1, 477, 479, 766
Operations on series and sequences
1236
Tauberian theorems
799, 1097, 1808, 2682
Special Functions:
Bessel functions
614, 615, 1030
Hypergeometric functions and generalizations
1892
Lamé functions
1093
Legendre functions, spherical harmonics
2870
Polynomials as functions, orthogonal polynomials
2871

MISCELLANEOUS

Bibliography
757

NUMERICAL ANALYSIS

Computing Machines:
Analogue computers
2767
Digital computers: coding and programming
344, 566, 1049, 2055
Results of computations by machine
1312, 1695, 2163, 2164
Numerical Methods
2735
Difference and functional equations
245, 948, 2568
Error analysis
341
Graphical methods, nomography
289, 549
Harmonic analysis, nomography
1799
Integral equations
1460, 1695, 1990
Interpolation, smoothing, least squares, curve fitting, approximation of functions
1586, 2657
Least squares
2027
Linear equations, determinants, matrices
1251, 1859
Monte Carlo methods
1494, 2403
Ordinary differential equations
1733
Partial differential equations
56, 945, 1304, 1695
Tables
2936

OTHER APPLICATIONS OF MATHEMATICS

Biology and Behavorial Sciences
427
Biology
250, 1614
Nervous networks
1513-1515, 1744, 1745
Psychology
1526, 2660
Economics, Management Science:
Management science, operations research
1242
Information and Communication Theory:
285, 1020, 1460, 1505, 1519, 2633, 2672, 2967-2969, 2972, 2974
Communication theory
355
Information theory
365, 425
Information, Communication, Control:
Codes, decoding
1462, 1474, 1863, 1865, 2638, 2971
Data processing
282, 1764, 2089, 2090, 2642

Mathematical Subject Classification

OTHER APPLICATIONS OF MATHEMATICS (cont'd)

Foundations, coding theorems
1427
Linguistics, machine translation
1429, 1473, 1475, 1476
Optimal control
1519, 2381
Statistical theory of communication channels, filters
286, 1788, 1854, 2380, 2382
Switching theory, relays
2639
Programming, Resource, Allocation, Games:
Games
1877, 1933, 1934
Servomechanisms and Control:
Control systems
281, 285, 287, 291, 745, 858, 1428, 1785-1787, 1789-1791, 2188-2190, 2348, 2365, 2367, 2385-2388, 2566, 2567, 2634
Servomechanisms
281, 356, 357, 359-363, 1428, 1791, 2635, 2648
Stability of control systems
2368

PHYSICAL APPLICATIONS OF MATHEMATICS

Astronomy:
Celestial mechanics
342, 714, 1228
Cosmology
2263
Orbits
335-337, 341
Radio astronomy
507, 1532, 1551
Stellar structure
897
Classical Thermodynamics, Heat Transfer:
197, 960, 1104, 1784, 2662, 2663, 2824
Chemical kinetics
6-8, 1096, 1270
Heat and mass transfer
739
Heat transfer
5, 56, 319, 592, 718, 1033, 1340, 1418, 1692, 1693, 1695, 2216
Mass transfer
1415
Elasticity, Plasticity:
Anisotropic bodies
524
Beams and rods
538, 1332, 2146
Elasticity: general theorems
1230, 1253, 1254, 1256-1258, 1800
Finite deformation
600, 1803
Foundations of mechanics of deformable solids
395, 601, 1299, 1602, 1897, 2709
Plane stress and strain
352-354, 524A, 540, 602, 619, 874, 1109, 1298, 1319, 1679, 1801, 1802, 1804, 2704, 2708, 2714
Plasticity, creep
2147, 2148, 2150, 2523, 2525
Plates, shells and membranes
1248, 1805, 1806
Soil mechanics
607, 609, 610
Stability, buckling, failure
2344, 2711-2713
Thermo-mechanics
524, 617, 618, 704, 2018, 2019, 2146, 2519, 2520, 2740
Three-dimensional problems
524
Torsion and bending
539, 1246
Vibrations, structural dynamics
671, 1259, 2165-2167, 2343, 2345-2347
Visco-elasticity
1579-1582, 1678
Fluid Mechanics, Acoustics
135, 136, 2005, 3041
Acoustics
769, 1486, 1518, 2771
Aerodynamics
2152, 2155-2157, 2159, 2778
Airfoil theory
583, 584, 2729
Boundary layer theory
171, 213, 416, 576, 586, 1278, 1279, 1414, 1416, 1737-1741, 2144, 2159, 2216, 2324, 2329, 2331, 2332, 2568, 2739
Compressible fluids: subsonic flow
2142, 2420-2422
Compressible fluids: supersonic and hypersonic flow
35-39, 78, 106, 169, 170, 181, 310, 591, 719, 1336, 2136-2138, 2319, 2738
Compressible fluids: transonic flow
179-181, 2142
Diffusion, filtering
871
Foundations
154, 3043, 3045
Free surface flows, water waves, jets, wakes
317, 587, 644, 925, 1034, 1231, 1314, 2143, 2145, 2162, 2212
Incompressible fluids with special boundaries
585
Magnetohydrodynamics
81, 83, 454, 594, 716, 1879, 2131, 2183, 2184, 2326, 2327, 2353, 2357, 2484, 2487
Magnetohydro- and aerodynamics
590, 2155
Magnetohydro- and aerodynamics, ionized gas flow
201, 202, 1315, 1316, 2123, 2156, 2160, 2322, 2433, 2434, 2478, 2485
Rarefied gas flow
1338, 1339, 2218-2221, 2223

PHYSICAL APPLICATIONS OF MATHEMATICS (cont'd)

Shock waves
74, 546, 549, 1817-1819, 1830, 1956, 2153, 2211, 2222, 2224, 2435, 2436, 2490, 2826
Stability of flow
33, 34, 1331, 1334, 1335, 2321, 2732-2737
Subsonic flow
1093
Turbulence
416, 1277, 1804, 1755, 1813, 1936
Viscous fluids
171, 575, 1317, 1779, 1780, 2215, 2330, 2331

Geophysics:
Meterology
541

Mechanics of Particles and Systems:
Exterior ballistics, artificial satellites
715, 1758, 1757, 2419, 2777
Foundations
1810
Oscillations, stability
205, 206, 209, 284, 292, 297, 483, 1093, 1232-1239

Optics, Electromagnetic Theory, Circuits:
Antennas, waveguides
749, 750, 1990, 2811, 2618
Circuits, networks
908-922, 1021, 1321, 1468, 1470, 1477, 1478, 1544, 1785, 2171-2173, 2178, 2185, 2187, 2191, 2840, 2845
Diffraction, scattering
508, 1835, 1838, 2410
Electromagnetic theory
215, 1443, 1545, 1880, 2408
Physical optics
1020, 2407
Technical applications
2847
Waves and radiation
211, 1540, 1959, 1993, 2174, 2181, 2802, 2809, 2622

Quantum Mechanics
1209, 1210
Atomic physics
1107, 1108, 1233, 1327-1329, 1747, 2125, 2544, 3015
Elementary particles
377, 379, 892, 923, 1204, 1205, 2546-2549, 2552, 2557, 2722, 2838, 2840-2842, 3022
General theory
771, 774, 786
Molecular physics
638, 640, 725, 726, 929, 961, 1058-1061, 1289, 1452, 2946, 2947, 2949, 2953, 2959, 2961, 3018
Nuclear physics
282, 283, 502, 883, 1140, 1191, 1192A, 1194, 1195, 1208, 1398, 1409, 1410, 1442, 1789, 2004, 2297, 2301, 2442, 2453, 2559, 2891, 2839, 2877, 2880, 2882, 2944, 2967, 3025
Quantum field theory
137-139, 252, 253, 257, 380, 381, 384, 408, 409, 411, 437, 438, 770, 772, 1199, 1382, 1394, 1397, 1398, 1402, 1538, 1603, 1844-1848, 2288, 2270, 2454, 2538, 2539, 2541, 2560-2582, 2585, 2805, 2688, 2889, 2718, 2843, 2886-2888
Quantum mechanics of many-bodied systems
277, 419, 2930-2940, 2943
Quantum statistical mechanics
779, 780, 1215, 1238, 1273, 2876
Scattering theory
142, 143, 265, 268, 276, 368, 382, 386, 659, 865, 899, 731, 732, 773, 775, 777, 1193, 1202, 1207, 1218, 1235, 1358, 1363, 1382, 1389, 1406, 2009, 2255-2259, 2267, 2270, 2299, 2543, 2547, 2558, 2563, 2564, 2690, 2895, 2898, 2787, 2878, 2879, 2954
Superconductivity and superfluidity
261, 2942
Weak interactions
141, 267, 1369, 2941

Relativity
137, 2006
General relativity
144-147, 1843, 1847, 2261, 2284, 2269, 2545, 2687, 2717, 2719-2721, 2723, 2725-2728, 2998
Special relativity
781, 2262, 2404

Statistical Physics, Structure of Matter:
Plasma
199, 213, 275, 897, 700, 1264, 1957, 2011, 2317, 2477, 2491, 2492, 2851, 2855, 2724, 3010, 3011
Transport processes, nuclear reactor theory
184, 897

Statistical Thermodynamics and Mechanics
3041
Collective motions
278
Gases
184, 1039-1041, 1274, 1812, 2687
Irreversible thermodynamics
183, 417, 418, 422, 889, 695, 896, 2885
Kinetic theory of gases
134-136, 140, 698, 1378, 2012, 2488, 2493
Quantum statistical mechanics
751, 752, 1237, 1240, 1287, 1497, 1812, 1816
Solids
1244
Statistical thermodynamics
1814, 1815, 3037-3040, 3042, 3044

Structure of Matter:
Crystallography
1234, 1243, 2065, 2066
Solid state
347, 1212, 1214, 1218, 1238, 1327-1329, 1484, 1930-1932

Mathematical Subject Classification

PROBABILITY

Applications
250, 785, 3047
Distributions
1891
Elementary Theory
1691
Markov Processes
858, 1687, 2512, 2670, 2671, 2673
Random Walks, Brownian Movement
2999
Stochastic Processes: general theory
432, 1587, 2236, 2509

STATISTICS

Applications
250, 971, 972, 1232, 1868, 1869, 1871, 1873, 2595
Design of Experiments
1850, 1851, 1855, 1862, 1863
Distributions of Statistical Functions
2, 405, 406, 607, 1860, 1861, 1891, 2510, 2511
Estimation Theory: parametric case
404, 1874
Multistage Decision Procedures, Sequential Analysis
596
Non-parametric Methods
1852
Sampling Surveys
407
Testing of Hypotheses: parametric case
1853, 1856, 1858, 1867, 1870

THEORY OF NUMBERS

Analytic:
Additive number theory, partitions
1866
General:
1302
Diophantine equations
2350
Elementary number theory
1313, 2073
Power residues, reciprocity laws
1300
Finite fields
2076

TOPOLOGICAL ALGEBRAIC STRUCTURES

Lie Groups and Algebras:
Lie algebras, Lie rings
240
Lie groups
240, 2851
Representations
2694

Topological Groups:
Semigroups
1948
Topological Groups and Lie Theory:
Representations
1303
Topological algebras
2505
Transformation groups
2072, 2078
Topological Vector Spaces, Functional Analysis:
Applications of functional analysis; analysis of differential and integral operators
2238
Group algebras
1309
Groups and semigroups of linear operators
2506, 2508, 2872
Hilbert spaces
439
Linear operators
248
Rings of operators, group algebras, abstract topological algebras and their representations
249
Spaces of continuous functions
1296, 2239-2241
Spectral theory
2278, 2282

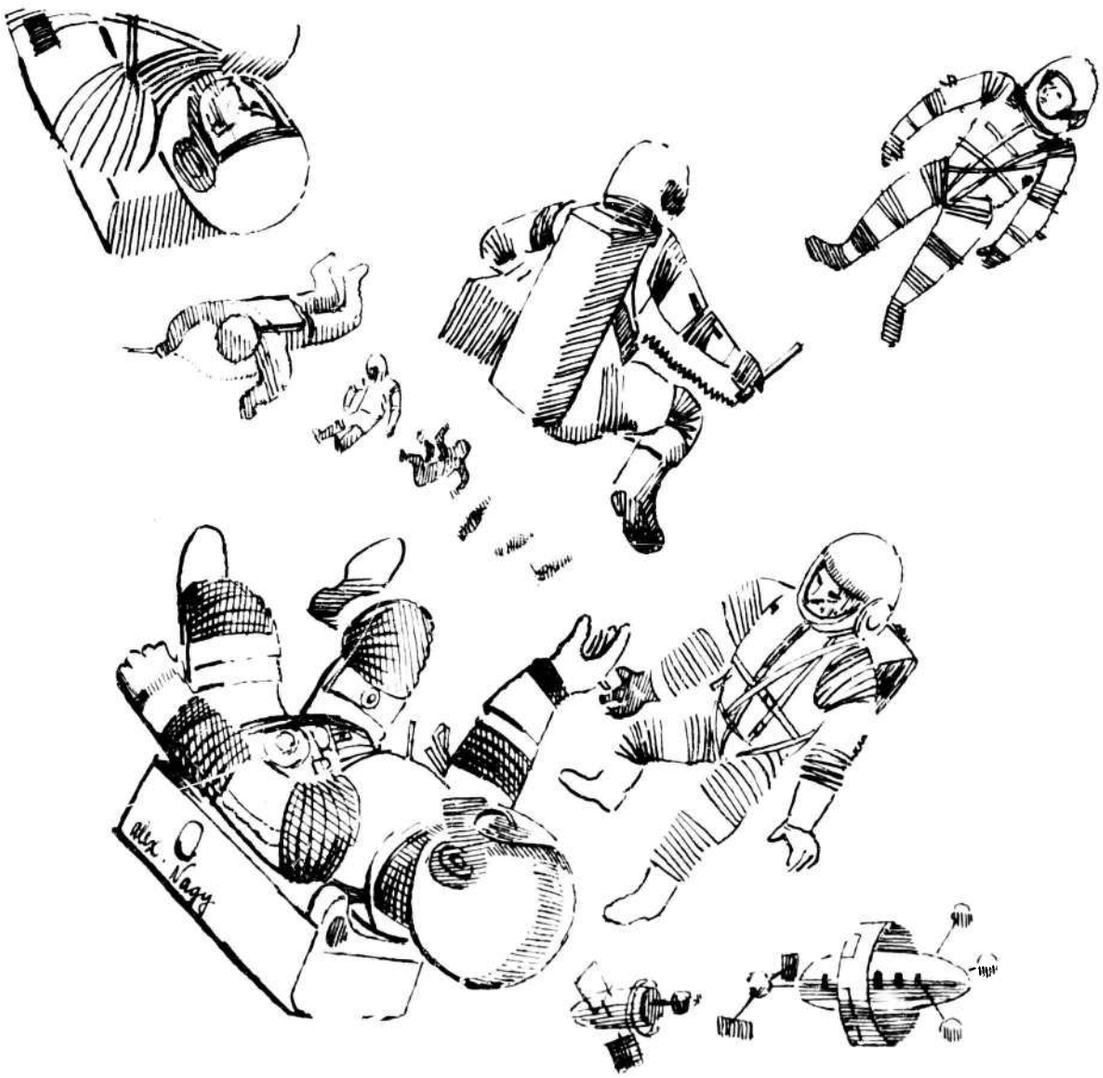
TOPOLOGY

Differential Topology:
Complex manifolds
942, 1620, 1872, 2231, 2233, 2376, 2384
Complex manifolds (Kähler, almost complex Hermitian)
2922
Differential structures, classification of
2232
Real differential manifolds, general
941
Topology: Algebraic
Applications to analysis
2172
Cohomology
241, 1308
Fiber bundles
1690, 2849
Graphs, four color problem
933
Homology
428, 2234
Homology and cohomology
429, 431, 2868
Homotopy
238, 239, 430, 2242, 2925-2929
Homotopy, general theory
2373
Manifolds
1617
Transformations and special mappings
1478

Mathematical Subject Classification

TOPOLOGY (cont'd)

Topology: General
2074
Fixed point properties
1950, 2844, 2847
Metric and uniform spaces
1305
Topological dynamics
1728, 1729, 2228
Topology of point sets, curves, continua
1949, 2273, 2274, 2378, 2845, 2846, 2850, 3005



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